User's Manual

FLOW INDICATOR TOTALISER

SMIT1019

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CONTENTS

1 INTRODUCTION
1.1 TECHNICAL DETAILS

2 SPECIFICATIONS

3 HARDWARE DESCRIPTIONS
3.1 CPU CARD
3.2 KB / DISPLAY CARD AND FRONT PANEL
3.3 ENCLOSURE
3.4 POWER SUPPLY
3.5 RELAY CARD

4 INSTALLATION GUIDE
4.1 CONNECTION DETAILS

5 OPERATING DETAILS
5.1 DISPLAY
5.2 KEYBOARD
5.3 RUN MODE
5.4 EDIT MODE
5.5 PARAMETER DESCRIPTION
-PROGRAMMING MODE
-CONFIGURATION MODE
-CALIBRATION MODE

6 CALIBRATION PROCEDURE

TABELS

Table 1 Specifications

Table 2 Connection Details

Table 3 Keyboard Details

Table 4 Run Mode Parameter Details

Table 5 Program Mode Parameter Details

Table 6 Configuration Mode Parameters Details

Table 7 Time base Setting details

Table 8 Five Point Linearization

Table 9 Calibration Mode Parameters Details

1. INTRODUCTION

This is a microcontroller based Indicator - Totaliser unit, with very high performance to price ratio. It is highly versatile, accurate and different from the conventional indicators.

1.1 TECHNICAL DETAILS:

The instrument is made in 96 x 96 x 110 mm size with DIN standard panel cutout of 92 x 92 mm.

Front is sealed membrane type to withstand dusty environment. On back plate detachable terminals are provided for easy connection.

The programming, calibration and operation of the instrument are by four simple keys and with two independent displays groups: one for flow rate and one for batch total. This unit is driven with user understandable prompts. For protecting programmed data password protection facility is provided. Integrated total, batch total and roll count are cleared by special password say 3210.

The product is made to accept current (4-20 mA, 0-20mA), Voltage (1-5Volt, 0-5 Volt) input, pulse input & Digital input. It is available as a single input version only. The instrument is providing with the five-point calibration. The unit can be calibrated in installed condition itself by front panel keys at predefine points.

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

2. SPECIFICATIONS

DISPLAY:

- 5 Digit 0.56" red LEDs for flow rate of output channel 1
- Digit 0.40" red LEDs for flow rate of output channel 2

KEYBOARD:

- Four keys membrane like.

INPUT:

- Current (4-20 mA, 0-20mA), Voltage (1-5Volt, 0-5 Volt), and Frequency

SCALING:

- Linear and square root extraction, Programmable

CALIBRATION:

- Zero and span adjusted by software calibration through front panel keys. No trim ports.

CONTROL:

- Control is given by Esc, Increase, Digit shift & Index (Enter) keys for operation, programming and calibration.

ACCURACY: ± 0.1% of F.S ± 1Digit

INPUT SIDE:		
	Input Impedance	250 Ohms
	CMRR	>100dB
	Resolution	20000 Counts
	NMRR	>50dB
	Accuracy	± 0.1% of F.S ± 1Digit.
	Isolation	Input & Logic supply provided thro' Opt isolator
	No of inputs	1
	Input type	0-20mA, 4-20mA
		0-5 VDC, 1-5VDC
		0-10 KHz
OUTPUT SIDE:		
	Maximum load	500 Ohms
	Resolution	5 uA/Count
	Accuracy	0.25% of Full scale
	Stability	5 ppm/C
	Response time	1 sec
	Temperature coefficients	± 3 ppm of FSR/Deg.

POWER SUPPLY:
Operating supply: 90-255VAC +/- 10% 50Hz

TRANSMITTER POWER SUPPLY: +24VDC ±5%@ 50mA

GENERAL:

- Operating Temperature Range: 0 – 55 Deg. C
- Humidity: 30 to 95% RH.
- Power consumption: Less than 10 VA.
- Contact Rating: 230VAC, 2 A
- Warm up time: 10 Minutes.

OPTIONAL:

- Flame proof housing
- Driving Thirteen Barrier screw type can accept up to 2.5 sq.mm wire.
- cutout: 92 x (8 + 5) digit multiplexed Display
- Four key keypad interface.
- Watch dog circuit.

PHYSICAL:

- Case: ABS Plastic
- Terminals: 92 mm
- Bezel size: 96 x 96mm.
- Depth behind panel: 110 mm maximum.

- ADS1110 circuit interface for input.
- DAC7571 circuit for current output.

3. HARDWARE DESCRIPTION

The unit consists of a CPU, KB/Display card and Power Supply (SMPS)

3.1 CPU CARD:

The CPU card has necessary hardware Relay card carries a 12-pin, 5.08 mm pitch, and detachable Male connector. The connectors are accessible from back panel cutout. Matching female connectors are supplied along with the instrument.

3.2 KB / DISPLAY CARD:

It carries 5-pin & 4 pin, 3.84mm pitch and detachable Male connectors. The connector is accessible from back panel cutout. Matching female connectors are supplied along with the instrument. The card is connected with KB/Display card and it is fitted with front & back plate.

FRONT PANEL:

A KB / Display card has two set of displays:

5-digit display for rate indication of output channel 1.
8-digit display for rate indication of output channel 2.

Four keys are also mounted on this card. The card is connected with CPU card with 20-pin connector. The card is fitted with the bezel. An overlay is provided on the front side.

3.3 ENCLOSURE:

This is general purpose DIN standard ABS Plastic enclosure suitable for panel mounting. Panel mounting is to be done using side brackets.

3.4 POWER SUPPLY:

This is a Switch mode power supply. It accepts mains input ranging from 90-255 VAC. It generates DC supply required for Logic & signal conditioning. It also generates +24VDC for transmitter.
The SMPS card carries a 3-pin, a 5 pin and a 2 pin, 5.08 mm pitch, detachable Male connectors. The connectors are accessible from back panel cutout. Matching female connectors are supplied along with the instrument.

3.5 RELAY CARD:

A Relay Card is connected between CPU card and SMPS card. It consists of 4 OMRON 12V DC Relays mounted with the help of side PCBs.

4. INSTALLATION GUIDE

Following steps should be followed for proper installation of the instrument.

1. Unpack the instrument from the packing Box carefully Mount the instrument in the panel cutout of 92mm x 92mm.
2. Fix the instrument with the panel using two side brackets.
3. All the electrical connections to be done at Back panel on screw type terminals.
4. Refer the Appendix for back panel connection.
5. Make sure that no wire is connected loosely to avoid generation of spark and RFI.
6. Before connecting the mains, check the mains configuration on the back panel.
7. Ensure that the instrument is properly earthed.
8. Check voltage between earth and neutral terminal. It should be less than 2 volts AC.
9. If this voltage is greater then it results in unstable reading. In such a case use ISOLATION TRANSFORMER to provide mains to the instrument.

4.1 CONNECTION DETAILS:

- These are the connection details:

No.	Detail		No.	Detail	
1	Line		**17**	C3	
2	Neutral		**18**	NO3	
3	Earth		**19**	NC3	
4	DIN1		**20**	C4	
5	DIN2		**21**	NO4	
6	DIN3		**22**	NC4	
7	DIN4		**23**	RxTx+	
8	COM		**24**	RxTx-	
9	POUT+		**25**	OUT+	
10	POUT-		**26**	OUT-	
11	C1		**27**	C	
12	NO1		**28**	I/P +ve	
13	NC1		**29**	I/P -ve	
14	C2		**30**	Pulse I/p (0-10KHz)	
15	NO2		**31**	24V DC (50mA)	
16	NC2				

5. 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.

5.1 DISPLAY:

The unit has two windows/groups of display:

Upper:

Five digits 7-segment, 0.56" Red LED display: It displays Flow rate/Process variable of output channel 1.

Lower:

Eight digits 7-segment 0.40" Red LED display:

In normal mode of operation, flow rate of output channel 2 is displayed. While in EDIT mode, parameters are displayed in this window.

5.2 KEYBOARD:

Unit has 4 key membrane keypad organized as 4 x 1 matrix. Following Table explain the Operation of the Keys used for configuration.

Key	Function
SET (Index)	1. It will allow user to enter in EDIT mode, when instrument is in RUN mode. 2. It will scroll menu and submenu when it is enabled 3. It will save edited data.
← (Decr)	1. It will enter into the submenu, when main menu is enabled and shows submenu's value. 2. It will select the digit to modify, when value is edited. 3. It will start batch, if pressed, when IT & BT are being displayed
↑ (Incr)	1. It will increment value of digit selected or constant selected. 2. It will stop batch, if pressed, when BT/IT are being displayed.
ESC (Cancel)	It will escape to previous status, with reference to its current status. Sequence of status: IT → MENU → SUB-MENU Parameter's Value ← → Escape sequence When Esc key is pressed in Menu, the instrument will come in RUN Mode. The unit will come out of EDIT Mode. If user wants to go in EDIT mode, he will have to enter the correct password again.

Note:- On pressing ESC key will display DENSITY value in upper display & DENSITY tag in lower display; it will display flow value after one minute if ESC is not pressed again.

5.3 RUN MODE:

Whenever mains are 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 batch total/integration total will be displayed on the lower window.

5.4 EDIT MODE:

In this mode user can verify or modify, various parameters. To enter the EDIT mode, correct password is to be entered.

Password Protection:

Whenever the instrument is powered on and INDEX key is pressed, a "PASSWORD" MSG will be displayed at lower panel 7-segment display. Press "START KEY" (It is digit select key for editing the parameters), password value "0000" is displayed.

Enter the correct password value with the help of START (digit select key) and STOP key (Incr key) and press INDEX KEY (INDEX key is used as ENTER key) If correct password is entered & INDEX key is pressed, it will show the first mode PROG MOD. If wrong password is entered, then "Password" MSG will be displayed again at lower display window.

Note: If user forgot the password then a default Password "1975" should be entered, it will reset the password to "0000".

5.5 PARAMETER DESCRIPTION:

There are total three Menu Items:

Following section will describe the different Item of individual submenu.

1.	**Program Mode**
2.	**Configuration Mode**
3.	**Calibration Mode**

Programming mode:

Programming menu provides facility to configure the relay for different function.

Low alarm and high alarm:

Value of Low alarm should be lower than that of high alarm. If user tries to set value of Low alarm greater than high alarm Value, error message will be displayed. Similarly, if user set value of High alarm lower than low alarm Value, error message will be displayed. Alarms value cannot be set greater than Full-scale Value (FS).

Comparison with Zero and full-scale:

Low Alarm value should be greater then Zero value. If user tries to set value of Low alarm less than Zero Value, error message will be displayed. If (Low Alarm< Zero value), "error" message appears. High-Alarm value should be less then Full-scale value. . If user

tries to set value of High-alarm greater than Full-scale value, error message will be displayed. If (High Alarm > full-scale value), “error” message appears.

Set point and pre warn:

Error message will be displayed if, set point value is lower than pre-warn and vice versa.

Alarm ON-OFF :(sub menu no 5 to 8):

Using these settings, user can set alarm/relay availability. If particular relay is set as ‘yes’, that particular alarm indication will be present over the display card and relay action will come into effect.

Configuration mode:

Details of configuration parameters, which will appear in configuration mode:

Sr. No	Name	Description	No Of Digit	Lo Limit	Hi Limit
1	Batch Mode	Type Of Mode, For Flow Control	-	Normal, Counter	
2	Input Type	Type Of Input	-	0-5v, 1-5v, 0-20ma, 4-20ma,Pulse	
3	Type Of Instrument	Type Of Instrument, Which You Want To Use.	-	Indicator/ Totaliser	
4	Square Root	Mode Of Linearization	-	Yes/No	
5	Digital Input	To Be Used To Reset Batch Total		Yes/No	
6	Digital Filter	If Yes Than In Programming Mode It Will Show Filter No.	-	Yes/No	
7	Time Base	For Calculation/Display Of Flow Rate	-	Sec, Min, Hour, Day	
8	ZR1	Zero Value	5	00000	30000
9	FS1	Full Scale Value	6	00000	20000
10	No Of Batches		2	00	99
11	Batch Count	Counter Will Count How Much Batches Has Been Taken	2	00	99
12	Relay Mode	Two Type Of Mode	-	Normal, Failsafe	
13	Cut Off		3	000	100
14	DP	Decimal Point	-	0,0.1,0.01,0.001	
15	SF1	Full Scale For Segment 1	6	00000	30000
16	SL1	% Age Of Full Scale (Segment 1)	-		
17	SF2	Full Scale For Segment 2	6	00000	30000

18	FL2	% Age Of Full Scale (Segment 2)	-		
19	SF3	Full Scale For Segment 3	6	00000	30000
20	FL3	% Age Of Full Scale (Segment 3)	-		
21	SF4	Full Scale For Segment 4	6	00000	30000
22	FL4	% Age Of Full Scale (Segment 4)	-		
23	SF5	Full Scale For Segment 5	6	00000	30000
24	FL5	% Age Of Full Scale (Segment 5)	-		
25	Baud Rate		-	9600,19200	
26	Serial no		2	00 to 99	
26	Pout		4	0001 to 9999	
27	Default Display		-	Batch Total/Integration Total	
28	Pass		4	0000-9999	
29	Conversion Factor		4	00.00-99.99	
30	Clear Total	To Clear Integration /Batch Total And Roll Count	4	"PAS" & 0000-9999	
31	Rounding		-	1,2,5,10	

Batch Mode:

If parameter 'Batch Mode' (Batch Mod) is selected to 'Counter', then two parameters "Batch count" (Bat cnt) and "No of Batches" (No_of_bh) will be displayed in Configuration mode. If 'Batch Mode' is selected to 'Normal', two parameters will not be displayed.

Input Type:

Based on requirement, user can select input type. It will be either Voltage or Current or Pulse.

Square root:

If user selects this mode as 'yes', flow rate will calculated using square root algorithm. Alternatively linear calculation will be done.

Batch counter and no of batches:

These parameters will be displayed only if the 'Batch mode' is selected to counter type.

No of batches:

Set the parameter according to the requirement. It decides how much batches are to be taken.

Batch counter:
It will be incremented by 1 whenever a new batch is started by START key in run mode. When batch counter value becomes equals to 'no of batches' value, then it will not *start* new batch.

Note: To reset batch counter, Enter in batch count (bat cnt) parameter in configuration mode. Press "Start" key to see its value. Now if user presses "Stop" key Batch counter value will be cleared to 0.

Relay-mode:

In '*Relay-mode'* (relay nod), if set to '*normal* 'mode then alarm relays and LEDs will work according to alarm values. I.e. Relays on, LEDs on, Relays off, LEDs off. But if set to '*Failsafe'* Mode then alarm relays and LEDs will operate reversibly. I.e. Relays on, LEDs off, Relays off, LEDs on.

Cut off:

Cut off could be set to 0000 to 0100. Cut off will display the % value.

Cutoff value = Cutoff parameter (in %)*Full-scale-value

If full-scale value is 10000 and cut off is 5%. Then cut off value will be calculated as (5/100)*10000 = 500. So, if the displayed flow rate (displayed at upper window) is less then 500, it will not be added in integration.

Decimal Point Selection:

Decimal point selection will be given from the configuration mode.

Select	Decimal position
0	No decimal
0.1	One decimal
0.01	Two decimals
0.001	Three decimals

Five point Linearization:

This instrument has feature of five-point linearization. User can define up-to five different segments of the full-scale input (in percentage) with Full-scale engineering value for each segment.

We have to program the value of flow rate at different inputs.

Here we are defining five scale factors for the current input 4 mA to 20mA. Let's have one example to understand this concept.

Default Display:

This parameter will select the parameter to be displayed in run mode. If Int tot / Bat tot is selected then in run mode 'Integration total '/ 'Batch total 'will be displayed on lower panel accordingly. If "*instrument type*" parameter is set as indicator, then this parameter will not be displayed in Configuration mode and Integration total will be displayed in run mode.

Password:

'PASS' parameter is added in configuration mode. But it will always show '0000'.User has to remember the password. If user needs to change password, then go in 'pass' parameter, enter the required password and press Enter key. For e.g. If user enters '1234' in 'pass' parameter, then, to enter in EDIT mode, a password '1234'is to be entered.

Calibration mode:

This menu allows user to perform calibration of analog input & output out zero and out

Sr. No	Setting	Description	No of digit	Lo limit	Hi limit
1	Cal Zr 1	Zero Cal. Count	4		
2	Cal SP1	Span Cal. Count	5		
3	Out Zr1	Zero Cal. Count for Output	4	0000	4095
4	Out SP1	Span Cal Count for Output	4	0000	4095
5	Out Zr1	Zero Cal. Count for Output	4	0000	4095
6	Out SP1	Span Cal Count for Output	4	0000	4095
7	Default Out	If user selects 'yes', then Out zero = 800 and Out span (4000) is selected.	Yes/No		

span. These two parameters are used for the calibration of re-transmission output. Users have to change the value of out zero and out span for the zero setting (for 4mA) and span setting (20 mA) respectively for re-transmission out put. If user enters values greater than 4095 "error" message will appear. It user enters out zero value > out span value then also "error" message will appear.

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:

Indication (Engineering Value)

[X/ (CALS-CALZ)] + Zero

X = (Input signal - CALZ) * (Full scale - 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 starts flashing. Only when input signal comes back into the allowed range, display becomes steady.

Note:
1). When no input is connected to the unit, it will display “open” message in pulse mode or current mode
2) When input is voltage type, then it will display “0”.
3). When input is out of the range the display will blink.

Accuracy of retransmission O/p - 0.25% of Full scale

6. Calibration Procedure:

Input Calibration:

As explained earlier, One can do calibration thro' the keyboard itself, Zero and Full-scale values are stored in NVRAM.

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 value. Apply output of the source to the input terminals of connector pin according to input select.

3. Go to ‘cal_zr1’ menu. Lower window displays a count. This is raw count proportional to analog input. Wait till counts are stable, save this count by pressing ‘Index’ key twice.

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

- Set output of the source at desired full-scale value.
- Apply output of the source to the input terminals
- Cal-span’ for Span calibration will be displayed.

- Raw counts of will be displayed.
- Allow the reading to settle and Press 'Index' Key twice to save the count.
- This reading will be stored as Span, now the instrument is calibrated.

7. MODBUS protocol

Here we will Two-function code:
Function code:
03h: for reading parameter value.
06h: for writing 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.

Sr. no	CMD.NO (Fun. No).	Parameter Name	Length in bytes (Words)	Read/Write
1	0001	High alarm	2(1)	R/W
2	0002	Low alarm	2(1)	R/W
3	0003	Setpoint	2(1)	R/W
4	0004	Setpoint+2	2(1)	R/W
5	0005	Prewarn	2(1)	R/W
6	0006	Prewarn+2	2(1)	R/W
7	0007	Conv-Factor	2(1)	R/W (00.00-99.99)
8	0008	Filter no	2(1)	R/W
9	0009	Batch mode	2(1)	R/W (Normal=0, Counter=1)
10	0010	Type of input	2(1)	R/W (0 -4) (for pulse it is 4)
11	0011	Type of Inst	2(1)	R/W (indicator =0 , Totalizer =1)
12	0012	Sqrt mode	2(1)	R/W (Yes =0, No=1)
13	0013	Digital input	2(1)	R/W (yes –0,no – 1)
14	0014	Digital filter	2(1)	R/W (yes –0,no – 1)
15	0015	Time base	2(1)	R/W (0-3)
16	0016	ZR	2(1)	R/W
17	0017	FS	2(1)	R/W
18	0018	No of batches	2(1)	R/W
19	0019	Batch counter	2(1)	Read only
20	0020	Relay mode	2(1)	R/W (normal =0.failsafe =1)
21	0021	Cut-off	2(1)	R/W (000.0 to 100.0)
22	0022	Dp	2(1)	R/W (0-3)
23	0023	SF1	2(1)	R/W (0-20000)

Sr. no	Reg. No.	Parameter	Length in byte (Word)	Read/Write
24	0024	FL1	2(1)	R/W (0-9)
25	0025	SF2	2(1)	R/W (0-20000)
26	0026	FL2	2(1)	R/W (0-9)
27	0027	SF3	2(1)	R/W (0-20000)
28	0028	FL3	2(1)	R/W (0-9)
29	0029	SF4	2(1)	R/W (0-20000)
30	0030	FL4	2(1)	R/W (0-9)
31	0031	SF5	2(1)	R/W (0-20000)
32	0032	FL5	2(1)	R (9)
33	0033	Baud rate	2(1)	R/W (19200-1,9600 -0)
34	0034	Serial no	2(1)	R/W
35	0035	Pout	2(1)	R/W (0000-9999)
36	0036	Default display	2(1)	R/W (0-batch total, 1-integration total)
37	0037	Out zero	2(1)	R/W (0000-4095)
38	0038	Out span	2(1)	R/W (0000-4095)
39	0039	Default out	2(1)	R/W (0 for yes /1 for no)
40	0040	Int total	2(1)	Read only
41	0041	Int total+2	2(1)	Read only
42	0042	Batch total	2(1)	Read only
43	0043	Batch total+2	2(1)	Read only
44	0044	Roll count	2(1)	Read only
45	0045	Flow rate	2(1)	Read only
46	0046	K FACTOR	2(1)	R/W
47	0047	K FACTOR+2	2(1)	R/W
48	1	Set point relay	1	R, digital
49	2	Prewarn relay	1	R, digital
50	3	High alarm relay	1	R, digital
51	4	Low alarm relay	1	R, digita1
52	5	Stop batch	0000	W, digital
53	5	Start batch	FF00	W, digital

Formula for K-FACTOR:

FLOW: - [(Pulse count per second *Time base)/ (K-FACT)]

Where,
Time Base value =

Number	Unit	Value
1	Second	1
2	Minute	60
3	Hour	3600
4	Day	86400

For example: - if we want to set FLOW value equals to 250.00 and remaining parameter at: -

- For Flow per minute:

  Time base = 2 = 60
  Pulse count = 10000
  Then FLOW = [(10000 * 60)/2400]
  FLOW = 250 per minute.

- For Flow per Hour:

  Time base = 3 = 3600
  Pulse count = 10000
  Then FLOW = [(10000 * 3600)/144000]
  FLOW = 250 per Hour.

Note: - K-factor works linearly at 60/minute.
For Retransmission Output, “F.S” parameter is provided.