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INTRODUCTION

Stick Type Master Controller is a crucial man & machine interface module to control the powering up, control and running of the Locomotive. Hence it requires reliable and ruggedized design to ensure trouble-free performance. Further, the Stick Type Master Controller should require less maintenance and shall minimize equipment downtime for attending repairs or periodic overhauling. In addition to this the Stick Type Master Controller should be designed in such a way that it shall occupy less space and shall be convenient & comfortable to be operated by the driver/pilot while sitting in his seat.

The Saitronik Electric Equipments has designed & developed the Stick Type Master Controller imbibing the above parameters into the system and also emphasizing the need to minimize the mechanical moving & rubbing parts and electrically more reliable switching contacts, to improve the reliability and to minimize the periodic maintenance.

The Saitronik's Stick Type Master Controller consists of basically two modules. They are:

(i) Mechanical CAM with mechanical interlocking facility as envisaged in the RDSO specification.
(ii) Auxiliary CAM switches, used to complete or fulfill the electrical circuits in sequential manner as defined in the specification or Locomotive maintenance manuals.

The Stick Type Master Controller is designed with three handles, which are as follows:

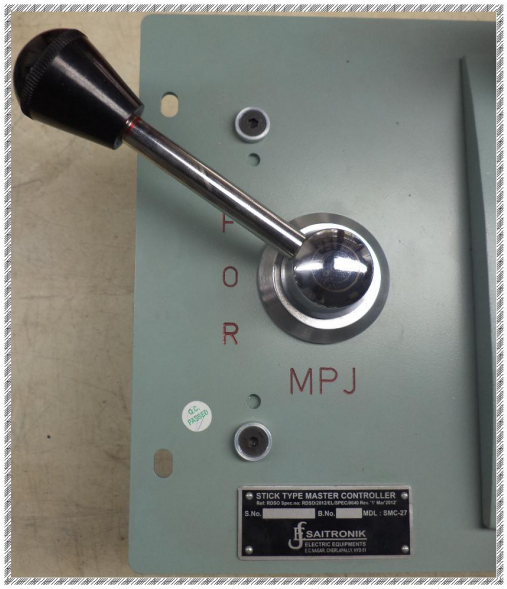
a) Reverser /MPJ Key
b) Throttle Handle (MP)
c) Field weakening handle/MPS

a) REVERSER /MPJ KEY:

The MPJ or Reverser/ MPJ Key have three positions marked as, **'F', '0'** and **'R'**. (`F' for Forward, `R' for Reverse and `0' for MPJ-0 positions)

The purpose of these handle is to move the Locomotive either in Forward or in Reverse direction. This MPJ Key / Reverser is removable one which can be inserted or withdrawn from the Master Controller in MPJ '0' position only.

The Master controller is operational only when this MPJ key is inserted and pressed to throw to Forward or Reverse direction to select forward / reverse movement of loco.



MPJ Handle is attached by a set of CAMs which operate the Auxiliary CAM switches. These CAM switches are as per CLW drawing no. 4TWD.241.164 . These Auxiliary CAM switches are used to make & break the contacts like J1 and J2 contactors of the Locomotive, which help the Locomotive to move either in forward or in Reverse direction

b) THROTTLE HANDEL (MP) :

The MP or Throttle Handle has eight positions marked as, **+, N,-, 0, P, -, N, +**
The purpose of this Handle is to operate the Locomotive either in Traction mode or in Braking mode. After inserting the MPJ key and selecting either 'F' (Forward) or 'R' (Reverse) positions the MP Handle gets unlocked.

There are two main divisions of this handle. Away from driver side of this handle is used for powering the locomotive for Traction.

The following positions are used for this application.

+, N, -, 0

Driver's side of this handle is used for powering the locomotive for Braking.

The following positions are used for this application.

P, -, N, +

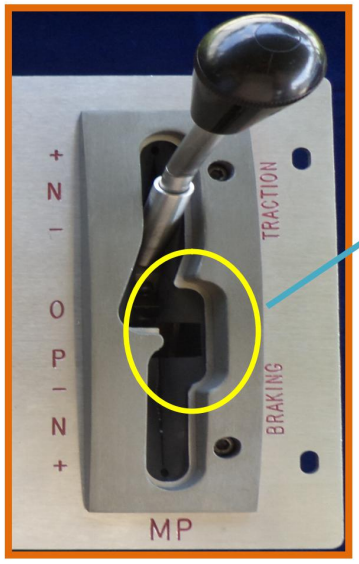
By moving the MP Handle to Traction 'N' the driver can Notch UP or Notch DOWN by moving the MP Handle towards '+' or '-' positions respectively.

Product ID: STICK TYPE MASTER CONTROLLER

Model/Type No: SMC-27 Rev 0

RDSO Spec No:RDSO/2012/EL/SPEC/0040 Rev.'1' March 2012

Doc Name: Technical Details Doc No: SMC-27_TD_R.0



"U" path for smooth transition from traction to braking without jerks, to protect traction motors.

The '0' position of MP handle is neutral position and 'P' position is for brake set up. When driver wants to bring the throttle (MP Handle) from traction side to braking side to apply dynamic breaking the MP Handle should not be brought to braking side instantly as this will affect traction motors & may lead to heavy jerk. To avoid this, a "**U"** path for MP Handle is made at the crossing junction. This redirects the throttle handle (MP Handle) from traction to braking and vice-versa for minimum time to change over (MTCO) operation.

In the Braking 'N' position the driver can increase or decrease the notches by moving the MP Handle towards '+' or '-' positions correspondingly. In Braking mode the Field Weakening Handel (MPS) will remain locked in zero position.

MP Handle is attached by a set of CAMs which operate the Auxiliary CAM switches. These CAM switches are as per CLW drawing no. **3TWD.101.138.** These Auxiliary CAM switches are used to make & break the contacts like SMGR UP, SMGR DN, Line contactors etc of the Locomotive. These contacts help the pilot to accelerate or decelerate speed of the locomotive in Traction or Braking mode respectively.

c) FIELD WEAKENING HANDLE (MPS):

The MPS or Field Weakening Handle has five positions, marked as: **0, 1, 2, 3** and **4**.

The MPS Handle will get activated mechanically only when the MP Handle is in Traction mode. The shunting Notches can be taken by the pilot as required by moving the handle to the respective position.

Fig: 05

Whenever the driver attempts to bring the MP Handle from Traction 'N' to notch down (-), the MPS Handle will automatically go back to its zero position & gets locked mechanically.

MPS Handle is attached by a set of CAMs which operate the Auxiliary CAM switches. These CAM switches are as per CLW drawing no. **3TWD.101.138.** These Auxiliary CAM switches are used to make & break the Shunting contactors of the Locomotive. These contacts help the Locomotive to move with the required speed.

ADVANTAGES

1. More leg space for loco pilot
2. Loco pilot can operate master controller in sitting posture.
3. Occupies less space because all the mechanical interlocks & contacts are replaced by a simple mechanism.
4. It is a light in weight (Approx. 23 kg) because of compact design and usage of special alloys. It can be lifted by single person easily to attend periodic maintenance.
5. Wear & tear is less as this design has less mechanical contacts.
6. Easy maintenance, because it is modular in design with ease to access contacts for periodic maintenance & dismantle.
7. Fully replaceable with the existing Master Controllers presently used in Locomotives.

Comparative statement between the existing Master Controller and the Saitronik's Stick Type Master Controller:

Sl. No	CLW Master Controller	Saitronik's Stick Type Master Controller
1	Large in size	Small in size
2	Heavy in weight (40 kg Approx)	Less in weight (< 23 Kg approx)
3	Different types of handling systems for the operation.	All the Handles are of similar type.
4	The operation of the handles & the wheel are in horizontal position, which will strain the pilot's arms.	All the Handles are operated in vertical position, reducing the strain to pilot shoulders.
5	Less leg space for pilot.	More leg space for pilot.
6	Maintenance problem	Easy maintenance

CONCLUSION:

The Saitronik's Stick Type Master Controller in combination of mechanical cams with auxiliary CAM switch contacts will achieve all required functions of master controller used in the existing locomotives. The unit occupies very less place on the driver desk and can be configured conveniently. It is anchored for the stability and comfort of pilot. It also helps for the beautification of the cab in the locomotives.

* * * * * * *

(A) Check the STMC for its functional performance in the test room before installing it in locomotive:

1. Unpack STMC and please take care that unit should not be dropped and avoid dragging of unit on metal surface to avoid scratches to unit.

2. Check the movement of MP, MPJ and MPS handles as per the loco operation & sequence and confirm that the mechanical interlock conditions are met with respect to Clause No. 6.1 of RDSO Specification no. ***RDSO/2012/EL/SPEC/0040 Rev.1 "March 2012"***

3. Check the functional performance as per (FTR) Functional Test Report Doc No. ***SMC-27_CON_IIR_01A(For Conventional Loco) and SMC-27_MPCS_IIR_01B*** (***For Microprocessor Loco)*** by using multi meter in continuity check mode in between the pins of 26 pin male circular connector as per FTR. The continuity should come at different pins at different positions of MP, MPJ and MPS handles detailed in FTR.

(B) Procedure for installation & commissioning of STMC in Conventional&MPCS Locomotives:

1. After successful verification of STMC functions as above in the test room the unit can be installed & commissioned in locomotive.

2. Before installing the STMC unit, make sure that the Loco battery is in **OFF condition.**

3. Place the STMC stand in the slot / provision given on the Driver's desk of the Loco CABs.

4. Fix the stand to the existing mounting pitch provided in the Loco driver's desk, by Three Nos of M10x60mm Palin Align head bolts & three nos of M10 spring washers.

5. Check & confirm that the stand is rigidly fixed to the Loco chassis.

6. Now place the STMC unit in the slot provided in the stand.

7. Fix the unit to the stand with four nos of M6x25mm Hexagonal bolts along with Four Nos of M6 plain washers and four nos of M6 Spring washers.or ***(If New BHEL Locos Now place the STMC unit in the slot provided on the Driver's desk. Fix the unit with four nos of M6x25mm Hexagonal bolts along***

with Four Nos of M6 plain washers and four nos of M6 Spring washers and Four nos of M6 Nuts.)

8. Check & confirm that the unit is rigidly fixed to the stand/slot.

9. **Existing Female** Couplers (A&B Type) from **SB/BD** panel to Master Controller in CAB-1& CAB2 side has to be removed or secured properly for use with drum type Master Controller.

10. Newly supplied 26 pin **Female circular connector** with cables shall be connected to **SB/BD** panel (in Both CABs). Wiring details of 26 pin **female circular connector** as per RDSO specification Cl.No 8.0 or follow the 26 pin circular connector wiring details supplied by M/s Saitronik) for correct wiring of it.

11. Spare connections **should not be connected to SB Panel**. SB/BD Side Spare cables to be **tied securely with proper ties** to avoid hanging or accidental contact with live parts.

12. Mate the 26 Pin Female circular connector to 26 pin male circular connector provided on STMC. Please ensure that the circular connector is mated properly and locked securely.

13. Turn 'ON' Loco battery & do the needful to get BP and MR is charged to required pressure.

14. After achieving required BP & MR pressure please 'Turn Off' HT (25KV) supply to loco and check functioning of STMC in LT supply.

15. After all STMC functions are checked, verified and satisfied by loco engineers than only HT supply of Loco should be turn on to run the locomotive by the authorized persons.

* * * * * * *

Product ID: STICK TYPE MASTER CONTROLLER

Model/Type No: SMC-27 Rev 0

Doc. Name: Wiring Details of 26 pin Circular Connector Doc No: SMC-27_WDC_R.0

Spec No: RDSO/2012/EL/SPEC/0040 Rev. 1 March2012

Sl No	Male coupler Pin No	Female coupler pin No	Female coupler Cable ferule no.ref.	Type of pin	Cable No for Female Coupler				Signal Name	SEE SUGGESTIONS
					conv.loco		MPCS .loco			
					MP-1/Cab1	MP-2/Cab2	MP-1/Cab 1	MP-2/Cab 2		
1	A	A	A5	O/P	#009	#010	#091	#092	j (Running Forward)	ok
2	B	B	A6	O/P	#010	#009	#092	#091	j (Running Reverse)	ok
3	C	C	A4	O/P	904	903	#097	#097	j (Braking Forward)	ok
4	D	D	A3	O/P	903	904	213	213	j (Braking Reverse)	ok
5	**E**	**E**	**B3**	**O/P**	**#079**	**#079**	**#096**	**#096**	**Q52 / MP- (DN) in MPCS**	**Modified**
6	F	F	A2	O/P	500	500	Spare	Spare	CCLSA	ok
7	G	G	B13	O/P	144	144	Spare	Spare	L1-L3,L4-L6	ok
8	H	H	B5	O/P	063 or 064	063 or 064	Spare	Spare	EMERGENCY UP/DN	ok
9	Y	Y	B15	O/P	#022	#022	Spare	Spare	Q50	ok
10	Z	Z	-	-	SPARE	SPARE	SPARE	SPARE	-	ok
11	a	a	-	-	SPARE	SPARE	SPARE	SPARE	-	ok
12	b	b	-	-	SPARE	SPARE	SPARE	SPARE	-	ok
13	d	d	-	-	SPARE	SPARE	SPARE	SPARE	-	ok
14	J	J	A19	O/P	#091	#091	123	123	S11,21,31,41,51,61	ok
15	K	K	A15	O/P	#092	#092	124	124	S12,22,32,42,52,62	ok
16	L	L	A18	O/P	#093	#093	125	125	S13,23,33,43,53,63	ok
17	M	M	A17	O/P	#093 or 094* as present	#093 or 094* as present	126	126	S14,24,34,44,54,64	ok
18	N	N	B16	I/P	023/1	023/2	Spare	Spare	Bat -ve	ok
19	P	P	B1	I/P	041/1	041/2	Spare	Spare	BL1 OR BL2-(6)	ok
20	R	R	B14	I/P	027/1	027/2	Spare	Spare	BL1 OR BL2-(5)	ok
21	S	S	A1	I/P	100	100	Spare	Spare	Bat +ve	ok
22	T	T	B6	O/P	#071	#072	Spare	Spare	Q46	ok
23	U	U	B9	I/P	005/1	005/2	F701/1	F701/2	BL1 OR BL2-(3)	ok
24	V	V	A16	I/P	#090	#090	Spare	Spare	GR 20th Notch	ok
25	W	W	B2	O/P	#045	#045	#093	#093	MP+ (UP)	ok
26	**X**	**X**	**B4**	**O/P**	**#055**	**#055**	**Spare**	**Spare**	**MP- (DN)**	**Modified**

A) HOW TO CONVERT STMC MICROPROCESSOR LOCO TO CONVENTIONAL LOCO

1) Two Terminal copper shorting links removed between 7F# & 8F# and connected between from 10F* & 11F*.
2) Jumper-1removed from 7F# and connected to 7F*.
3) Two terminal copper shorting link removed between 7R# & 8R# and connected between from 1R# & 2R#
4) Jumper-2 removed from 2R* and connected to 2R#.
5) Jumper-6 removed from 1R* and connected to 1R#.
6) Jumper-7 removed from 4R# and connected to 8R#.

* * * * * * *

A) HOW TO CONVERT STMC CONVENTIONAL LOCO TO MICROPROCSSOR.LOCO.

1) Two Terminal copper shorting link removed between 10F* & 11F* and connected between from 7F# & 8F#.
2) Jumper-1 removed from 7F* and connected to 7F#.
3) Two terminal copper shorting link removed between 1R# & 2R# and connected between from 7R# & 8R#.
4) Jumper-2 removed from 2R# and connected to 2R*
5) Jumper-6 removed from 1R# and connected to 1R*.
6) Jumper-7 one end removed from 8R# and connected to 4R#.

* * * * * * *

Visual,Electrical & Functional Testing Sheet of STMC (Conventional)

REF: SPEC No - RDSO/2012/EL/SPEC/0040 Rev. 1 **Model No:- SMC-27 Rev-0** **Doc No : SMC-27_CON_IIR_01A**

1) For MP handle:

Sl No	26 Pin Male Coupler Plug pin Nos(28-12P)	Ferule Ref no.of Female coupler Socket (28-12S)	MP Handle positions								Unit SL Nos							Observations/ Remarks
			Traction			MP(0)	Braking											
			(+)	(N)	(-)	0	(P)	(-)	(N)	(+)								
1	P-W	B1-B2																
2	P-E	B1-B3																
3	P-X	B1-B4																
4	P-H	B1-B5																
5	P-T	B1-B6																
6	U-D	B9-A3																
7	U-C	B9-A4																
8	U-A	B9-A5																
9	U-B	B9-A6																
10	R-G	B14-B13																
11	N-Y	B16-B15																

2) For MPJ Handle:

Sl No	26 Pin Male Coupler Plug pin Nos(28-12P)	Ferule Ref no.of Female coupler Socket (28-12S)	MPJ Handle Position			Unit SL Nos							Observations/ Remarks
			F	0	R								
1	S-F	A1-A2											
2	U-A	B9-A5											
3	U-B	B9-A6											
4	U-C	B9-A4											
5	U-D	B9-A3											

3) MPS handle

Sl No	26 PIN MALE COUPLER NOS	Ferule Ref no.of Female coupler Plug (28-12P)	MPS Handle Position					Unit SL Nos							Observations/ Remarks
			0	1	2	3	4								
1	V-J	A16-A19													
2	V-K	A16-A15													
3	V-L	A16-A18													
4	V-M	A16-A17													

	Type of Test	Parameters	Specified Values	Observed Values							Remarks
a	**Visual**	Length	400 mm ± 3mm								
		Width	250 mm ± 3mm								
		Depth	175 mm Max.								
		CD Length wise	372mm ± 1mm								
		CD Width wise	160mm ± 1mm								
b	**Electrical Test**	Insulation Resistance test with 500V Megger	>200MΩ								
c	**Dielectric Test**	Between live parts & Frame ; and Two Adj. Aux. Contacts	1.5 KV AC/60sec.								

Tested By: **Approved By:** **Verified By:**

Date: **Date:** **Date:**

Visual,Electrical & Functional Testing Sheet of STMC (MPCS)

REF: SPEC No - RDSO/2012/EL/SPEC/0040 Rev. 1 **Model No:- SMC-27 Rev-0** **Doc No : SMC-27_MPCS_IIR_01B**

1) For MP handle:

Sl No	26 Pin Male Coupler Plug pin Nos(28-12P)	Ferule Ref no.of Female coupler Socket (28-12S)	MP Handle positions								Unit SL Nos							Observations/ Remarks
			Traction			MP(0)	Braking											
			(+)	(N)	(-)	0	(P)	(-)	(N)	(+)								
1	P-W	B1-B2																
2	P-E	B1-B3																
3	P-X	B1-B4																
4	P-H	B1-B5																
5	P-T	B1-B6																
6	U-D	B9-A3																
7	U-C	B9-A4																
8	U-A	B9-A5																
9	U-B	B9-A6																
10	R-G	B14-B13																
11	N-Y	B16-B15																

2) For MPJ Handle:

Sl No	26 Pin Male Coupler Plug pin Nos(28-12P)	Ferule Ref no.of Female coupler Socket (28-12S)	MPJ Handle Position			Unit SL Nos							Observations/ Remarks
			F	0	R								
1	S-F	A1-A2											
2	U-A	B9-A5											
3	U-B	B9-A6											
4	U-C	B9-A4											
5	U-D	B9-A3											

3) MPS handle

sl No	26 PIN MALE COUPLER NOS	Ferule Ref no.of Female coupler Plug (28-12P)	MPS Handle Position					Unit SL Nos							Observations/ Remarks
			0	1	2	3	4								
1	V-J	A16-A19													
2	V-K	A16-A15													
3	V-L	A16-A18													
4	V-M	A16-A17													

	Type of Test	Parameters	Specified Values	Observed Values							
a	**Visual**	Length	400 mm ± 3mm								
		Width	250 mm ± 3mm								
		Depth	175 mm Max.								
		CD Length wise	372mm ± 1mm								
		CD Width wise	160mm ± 1mm								
b	**Electrical Test**	Insulation Resistance test with 500V Megger	>200MΩ								
c	**Dielectric Test**	Between live parts & Frame ; and Two Adj. Aux. Contacts	1.5 KV AC/60sec.								

Tested By: **Approved By:** **Verified By:**

Date: **Date:** **Date:**

Product ID: STICK TYPE MASTER CONTROLLER

Model/Type No: SMC-27 Rev 0

RDSO Spec No :RDSO/2012/EL/SPEC/0040 Rev.'1' March 2012

Doc Name: Dis-assembling Procedure Doc No: SMC-27_DAP_R.0

S.No	Sequence of Operation	Hardware	Tools used
1	Remove front (F) and Rear cover (R) from unit.	M5x10 cheese head MS nickel plating (10 Nos).	Screw driver
2	Keep the MPJ, MPS & MP at zero positions, and remove MPJ Key from STMC & remove knobs for MP.	----	---
3	Remove Switch mounting beam from rear (R) side & unlock the M12 nut & remove MPS handle from MPS Oscillator. And also remove switch mounting beam front (F) side.	M6x25 CSK align head unbroko screws with cup washers, two sets. M12 nut	4 mm align key 18-19 D spanner
4	Remove top cover from unit .	a) M6 Hexagonal nuts MS nickel plating (4 Nos). b) M6x30 plain align screws(2 Nos)	a) 10-11 D spanner b) 4 & 5 mm align keys.
5	Remove lever lock plate.	M4x12 plain align key head (8 Nos) with plain and spring washers (8 sets).	3 mm align key
6	Remove MP, MPS roller housing assemblies from bottom plate.	M6x25CSK align head unbroko screws (8 Nos)	4 mm align key.
7	Remove RHS plate, and bearings from at the one end of center shaft at MP cams side.	a) M6x16 CSK align head unbroko screws along with cup washers (2 Sets). b) M5x20 plain align head unbroko screws along with plain and spring washers (3 sets).	4 mm align key. Nylon hammer
8	Remove center shaft from T-Angle including MP, MPS cam assemblies, Torsion spring_MPS Oscillator and Bearing. .	-	---
9	Remove lock plate mounting blocks from Lock plate mounting shaft		

S.No	Sequence of Operation	Hardware	Tools used
10	Remove lock plate mounting shafts from LHS plate & remove LHS plate from bottom plate.	a) M6x16 CSK align head unbroko screws along with cup washers (2 Sets). b) M5x20 plain align head unbroko screws along with plain and spring washers (3 sets).	4 mm align key. Nylon hammer
11	Remove MPJ cam assembly from T-Angle & bottom plate.	M6x16 with cup washer (2 sets) M6x25 CSK align head screws along with plain and spring washers MS Nickel plating (4 Sets)	4 mm align key.
12	Remove T-Angle from bottom plate.	M6x20 CSK align head screws.	4 mm align key.

Product ID: STICK TYPE MASTER CONTROLLER

Model/Type No: SMC-27 Rev 0

RDSO Spec No :RDSO/2012/EL/SPEC/0040 Rev.'1' March 2012

Doc Name: Assembling Procedure Doc No: SMC-27_ASP_R.0

S.No	Sequence of Operation	Hardware	Tools used
1	Fix T-Angle to bottom plate.	M6x20 CSK align head screws.	4 mm align key.
2	Fix the MPJ Module assembly to bottom plate and T-Angle	M6x16 with cup washer (2 sets) M6x25 CSK align head screws along with plain and spring washers &NutsMS Nickel plating (4 Sets)	4 mm align key.
3	Fix the LHS plate to bottom plate	M5x20 plain align head unbroko screws along with plain and spring washers (3 sets).	
4	Fix the lock plate mounting shafts to Left hand side plate (LHS) and apply grease.	M6x16 CSK align head unbroko screws along with cup washers (2 Sets).	
5	Insert the lock plate mounting blocks to lock plate mounting shafts in proper direction.		
6	Apply grease to the center shaft. Attach MPS cams module assembly & MP cams module assembly to the center shaft.		
7	Attach the Torsion spring_MPS Oscillator in proper direction at the MP cams module side to T-Angle & after applying grease fix the bearing in between to the center shaft and T-Angle.		
8	Insert the bearing on other side and match the center shaft & lock plate mounting shafts and align & fix with Right hand side plate (RHS) to bottom plate.	M6x16 CSK align head unbroko screws along with cup washers (2 Sets). M5x20 plain align head unbroko screws along with plain and spring washers (3 sets).	4 mm align key. Nylon hammer
9	Apply grease to MP & MPS roller housing assemblies then fix to bottom plate.	M6x25CSK align head unbroko screws (8 Nos).	4 mm align key.
10	Make sure that the charging spring for MPS handle is ok; otherwise Charged in proper charging.		

S.No	Sequence of Operation	Hardware	Tools used
11	Fix the lever lock plate to lock plate mounting blocks & check the free movement of lock plate	M4x12 plain align key head (8 Nos) with plain and spring washers (8 sets).	3 mm align key
12	Fix Top cover to unit and lock with M6 nuts.	M6 Hexagonal nuts MS nickel plating (4 Nos). M6x30 plain align screws(2 Nos) M6x30 CSK align screws(2 Nos)	a) 10-11 D spanner b) 4 & 5 mm align keys.
13	Fix the MPS handle to MPS Oscillator then Lock with M12 Lock Nut.	M12 Hexagonal Lock Nut SS	18-19 D spanner
14	Fix the Knobs to MPS&MP Handles with Thread Lock.	Thread Lock	
15	Fix the Switch mounting beam Front and Rear one end to T-Angle & another end to RHS plate.	M6x25 CSK align head unbroko screws with cup washers, 04 sets.	4 mm align key
16	Check the Functional Test of STMC Unit as per test Document No.SMC-27_CON_IIR_01A R.0 and SMC-27_MPCS_IIR_01B R.0		Continuity tester
17	Fix the front (F) and rear (R) covers to unit.	M5x10 cheese head MS nickel Plating (10 Nos).	Screw driver