

ウガンダ共和国
建設交通省
(MOWT)

ウガンダ国
大カンパラ都市圏
道路網および交通改善計画調査報告書

信号機操作および管理マニュアル

和文要約版



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独立行政法人 国際協力機構 (JICA)

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信号操作および管理マニュアル 和文要約版

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第一部 計画マニュアル

1.1 はじめに

交差点では、車が合流、分流、あるいは交差し、これに歩行者も加わり複雑な交通現象を起こします。もし、信号機がなければ、さまざまな方向から走行する車であふれ、歩行者は待つことを余儀なくされます。信号機は、このような状況を改善するために大切な役割を果たしています。

1.2 信号機の役割

(1) 信号機の役割

- 交通事故の防止
- スムーズな交通流の確保
- 交通環境の改善

(2) 信号機の設置基準

日本の信号機設置基準では、以下の6つの条件にあてはまる場合に信号機が設置されます。

- 交差する道路相互の道路幅員が広く、交通量が多い場合
- 歩行者の横断が多い場合
- 交通事故の防止に効果的な場合
- 学童の横断および視覚障害者の横断が考慮される場合
- 病院等の公共施設付近
- 自転車交通の管理が必要な場合

(3) どのように交通現象をとらえるのか

信号機を制御するには車の動きをとらえる必要があります。この情報を得ないことには、最適な制御はできません。具体的には以下のようなデータにて交通現象をとらえます。

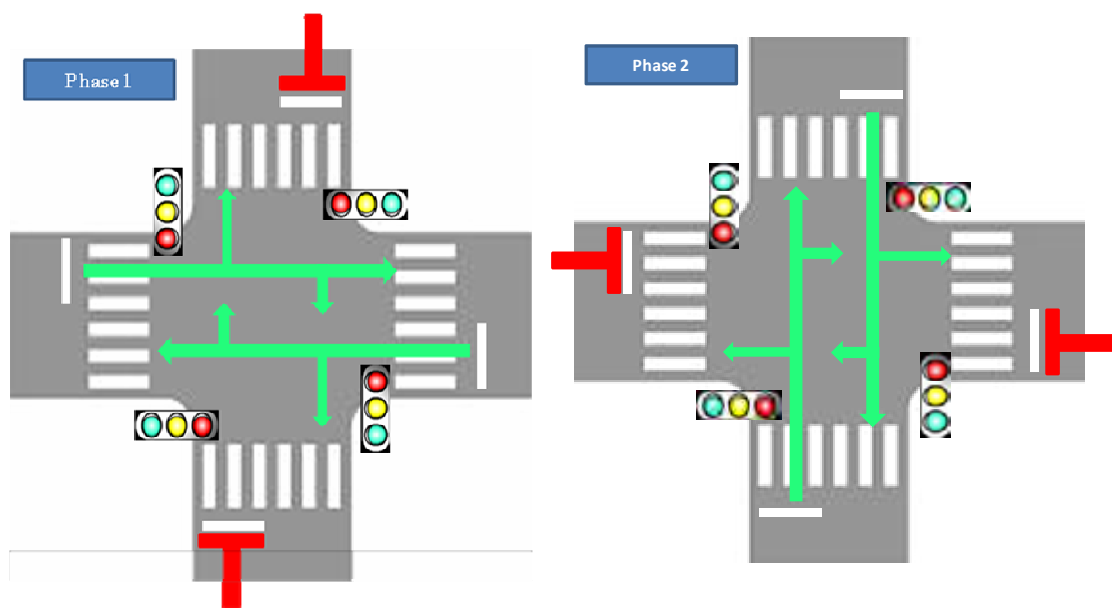
- 交通量
- 旅行速度
- 交通密度

1.3 信号機の現示

(1) 現示とは

異なった方向の交通流は、信号機により順番に通行権が与えられます。すなわち、青信号の表示により特定方向の車と歩行者のみが通行できます。この一群の交通の流れに通

行権が与えられる時間帯を現示とといいます。



(2) 制御のための3つのパラメーター

信号機を点灯する場合、タイミングの設定が重要になります。そのタイミングの表しかたには、「サイクル」、「スプリット」、「オフセット」の3種があります。

(3) クリアランス時間とは

信号機の現示の変わり目には、両方向から走ってくる車が衝突しないようにすることが必要です。したがって、この現示の変わり目には、交差点内の車両を一掃するための時間を設けています。この車両一掃に必要な時間を「クリアランス時間」といい、黄信号と全赤信号でつくられています。

(4) 歩行者横断時間

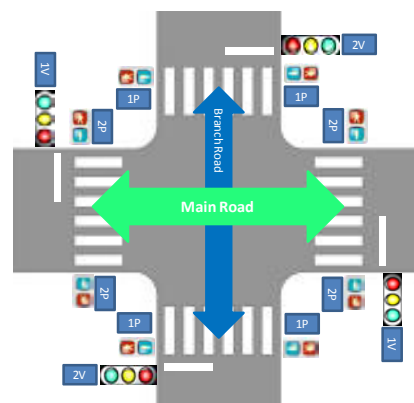
歩行者青時間と青点滅時間は、歩行者が道路を安全に横断するためのものです。

歩行者青時間が短すぎると歩行者が渡りきれず、また長すぎると、右・左折車が交差点に滞留し、渋滞の原因となります。したがって、歩行者青時間は適切に設定する必要があります。

(5) 信号の現示

右左折車あまり多くない場合には、主道路方向と従道路方向の現示を交互に表示します。十字路交差点の標準的な灯器配置は、右図のようになります。1と2は車両灯を示し、1Pと2Pは歩行者灯を示します。1と1Pは主道路方向の現示を表示し、2と2Pは従道路方向の現示を表示します。

信号現示の切りかえタイミングをステップといい、2



現示10ステップの信号機が最も一般的なものです。この切りかえのタイミングを表現するのに、下図のような現示図を使用します。

Step	1	2	3	4	5	6	7	8	9	10
1P										
1V										
2P										
2V										
Time (s)	45	5	5	3	2	25	5	5	3	2
Phase	1					2				
Flow										

←--- Pedestrian Flow
 → Vehicle Flow

Vehicle and/or Pedestrian Green-light
 Vehicle Yellow-light
 Vehicle and/or Pedestrian Red-light
 Pedestrian Green-light blinking

1.4 信号制御の種類

(1) 地点制御（多段制御）

交通量は朝・昼・夕、また、平日・土曜・休日で変化しているにもかかわらず、青時間がいつも同じでは問題です。そこで交通量を調査して、時間帯別、曜日別に最適な青時間を設定するようにしています。これが多段制御です。

(2) 系統制御

信号機が連続して設置されている路線で、それぞれの信号機がバラバラに作動した場合、車は赤信号のたびに赤で止められ、ムダ時間や渋滞が発生しやすくなります。これを緩和するために、連続して設置されている信号機を互いに関連づけて動作させ、車をスムーズに走行させる方式です。

(3) 地域制御

主要都市では、交通量の多い幹線道路や中小の道路が複雑に交差し、多くの車や人が行き来しています。このような地域では、事故の防止やスムーズな流れをつくり出すために多くの信号機が設置されます。これらの信号機がバラバラに動作した場合には、都市の交通は大混乱を招くこととなります。したがって、複雑に絡みあう都市の道路交通を効率良くコントロールするための方法として、地域制御が必要となります。

第二部 定期点検マニュアル

定期点検は、「点検シート」に記載された間隔で必ず行う。不良が見つかった場合は、その場または後日改めて処置・部品等の交換を行う。実施した作業内容は「作業シート」に必ず記載する。

2.1 信号設備の保守点検

(1) 配電盤の点検

- 配電盤本体の損傷（傷・サビ等）がないことを確認する。損傷がある場合は処置を行う。
- 配電盤外部・内部の埃や汚れを清掃する。
- 取付ボルト類・ネジ類の締付状態を確認する。ゆるみがある場合は増し締めする。
- 端子に接続されている配線にゆるみ・抜けがないか確認する。ゆるみ・抜けがある場合は結線をし直す。
- 各配線の被覆に損傷がないか確認する。損傷がある場合はビニールテープを巻いて処置を行う。
- 商用電源入力部の電圧を測定する。

(2) 交通信号制御機の点検

- 制御機本体の損傷（傷・サビなど）がないことを確認する。損傷がある場合は処置を行う。
- 制御機外部・内部の埃や汚れを清掃する。
- 取付ボルト類・ネジ類の締付状態を確認する。ゆるみがある場合は増し締めする。
- 端子に接続されている配線にゆるみ・抜けがないか確認する。ゆるみ・抜けがある場合は結線をし直す。
- 各配線の被覆に損傷がないか確認する。損傷がある場合はビニールテープを巻いて処置を行う。
- 制御機の日付・時刻を確認する。ずれている場合は再設定する。
- 電源入力部の電圧を測定する。
- 灯器出力部の電圧を測定する。
- 制御電源部の電圧を測定する。

(3) 交通信号灯器の点検

- 灯器本体の損傷（傷・穴開き・サビ）がないことを確認する。損傷がある場合は処置を行う。
- 灯器外部・内部の埃や汚れ、およびレンズ面を清掃する。
- 取付ボルト類・ネジ類の締付状態を確認する。ゆるみがある場合は増し締めする。
- 端子に接続されている配線にゆるみ・抜けがないか確認する。ゆるみ・抜けがある場合は結線をし直す。
- 各配線の被覆に損傷がないか確認する。損傷がある場合はビニールテープを巻いて処置を行う。

- 信号灯器の向きを所定の位置から確認し、視認性に問題がないことを確認する。見づらくなっている場合は向きを調整する。
 - 各灯の点灯状態を確認する。
- (4) 信号柱の点検
- 柱本体の損傷（穴開き・傾き・曲がり・傷・サビ等）がないことを確認する。
 - 柱の基礎・根元部分の損傷がないことを確認する。
 - 柱に取り付けられた貼紙や看板などを除去し、清掃を行う。
- (5) ハンドホールの点検
- ハンドホール蓋の損傷（割れ・ひび等）がないことを確認する。大きく損傷して危険がある場合は補強・交換を行う。
 - 蓋を開けて、内部のマス損傷（ひび・欠損）がないことを確認する。損傷がある場合はセメント・モルタルで埋めて処置を行う。
 - 内部に水や異物がたまっていないかどうか確認する。たまっていた場合は排除する。
 - 内部の信号ケーブルに損傷がないか確認する。損傷がある場合はビニールテープなどで処置を行う。
 - 蓋がガタつかないように、枠の溝など各部を清掃して確実に蓋を閉める。

2.2 電源設備の保守点検

- (1) 自動起動式発電機の燃料補給
- 発電機の燃料がなくなる前に、燃料を補充する。作業日・給油量を記録する。
 - 積算運転時間を確認し、記録する。
 - 操作パネル面にエラーが表示されていないことを確認する。エラー表示があった場合は、取扱説明書に基づいて処置を行い、リセットする。
 - 燃料漏れがないことを確認する。漏れている場合は処置・清掃を行う。
 - 発電機を運転し、異音・異臭・異常な振動がないことを確認する。
- (2) 自動起動式発電機の点検
- 発電機本体の損傷（傷・サビ等）がないことを確認する。損傷がある場合は処置を行う。
 - エンジンオイル漏れがないことを確認する。オイル漏れが認められる場合は清掃し、該当箇所を補修する。
 - エンジンオイルを交換する。使用したオイルの量を記録する。
 - オイルフィルターの清掃を行う。清掃しても汚れが取れない場合は交換する。
 - 燃料フィルターの清掃を行う。清掃しても汚れが取れない場合は交換する。
 - 燃料タンクの水抜きを行う。
 - エアクリーナの清掃を行う。清掃しても汚れが取れない場合は交換する。
 - 発電機外部・内部、吸気フィルターの埃や汚れを清掃する。
 - 取付ボルト類・ネジ類の締付状態を確認する。ゆるみがある場合は増し締めする。
 - 端子に接続されている配線にゆるみ・抜けがないか確認する。ゆるみ・抜けがある場合は結線をし直す。

- 各配線の被覆に損傷がないか確認する。損傷がある場合はビニールテープを巻いて処置を行う。
 - 発電機の日付・時刻を確認する。ずれている場合は再設定する。
 - 出力電圧を測定する。
 - 出力電流を測定する。
- (3) 定電圧電源装置の点検
- 定電圧電源装置の埃や汚れを清掃する。
 - 端子に接続されている配線にゆるみ・抜けがないか確認する。ゆるみ・抜けがある場合は結線をし直す。
 - 各配線の被覆に損傷がないか確認する。損傷がある場合はビニールテープを巻いて処置を行う。
 - 入力電圧を測定する。
 - 入力電流を測定する。
 - 出力電圧を測定する。
 - 出力電流を測定する。
- (4) 無停電電源装置の点検
- 無停電電源装置の本体および前面パネルを開けて吸気口の埃や汚れを清掃する。
 - 接続されている配線にゆるみ・抜けがないか確認する。ゆるみ・抜けがある場合は結線をし直す。
 - 各配線の被覆に損傷がないか確認する。損傷がある場合はビニールテープを巻いて処置を行う。
 - セルフテストボタンを押下し、バッテリーの寿命が充分であることを確認する。寿命低下サインが出たらバッテリーを交換する。

2.3 点検シート

効率的な維持管理作業を実施するために、以下に示す「点検シート」を作成した。

- 交通信号機 点検シート (配電盤・交通信号制御機)
- 交通信号機 点検シート (信号灯器 車両用)
- 交通信号機 点検シート (信号灯器 3連矢印用)
- 交通信号機 点検シート (信号灯器 単体矢印用)
- 交通信号機 点検シート (信号灯器 歩行者用)
- 交通信号機 点検シート (信号柱)
- 交通信号機 点検シート (ハンドホール)
- 電源設備 点検シート (自動起動式発電機・定電圧電源装置・無停電電源装置)
- 自動起動式発電機 給油作業シート
- 交通信号機・電源設備 作業シート

- 工具確認シート
- 予備品リスト

第三部 操作マニュアル

3.1 電力設備

Matsunaga

OPERATING INSTRUCTIONS

AUTOMATIC VOLTAGE REGULATOR

TSA-1030-CJ



株式会社 松永製作所

Matsunaga Manufacturing Co., Ltd.

CAUTIONS FOR SAFETY

Read "CAUTIONS FOR SAFETY" well before the operation of the unit and treat the unit properly.

☆The below mentioned warnings are for your safe and secure use of the unit in order to avoid troubles and harms. Wrong treatments may cause some dangerous situations, which we here divide to three categories as "DANGER" "WARNING" & "CARE". Follow surely to this important notice.

☆The marks and their meanings are as the below.



DANGER

There have potential danger of death or serious injury. And the emergency measure shall be taken, if this situation happens. (highest urgency and danger)



WARNING

There have potential danger of death or serious injury.



CARE

There have potential danger of slight injury and material damage.

MEANINGS OF MARKS



PROHIBITION



NECESSARY PRACTICE



Keep several limitations prescribed here and do not excessive treatments and uses. And make properly routine checks and maintenances for preventing all troubles. This "CAUTIONS FOR SAFETY" must be kept beside of persons in charge of operation and/or maintenance.



DANGER

CONNECTING WORKS TO THE POWER SOURCE



(ELECTRIC WORK)

Several regulations are prepared depend on classes of facilities. The work must be followed to the regulations of each country.



(INSTALLATION, CHECK, REPAIR & OPERATION OF CHARGING ROUTE)

Only engineers who have studied specially about electricity must attend.



(GROUNDING WORK)

Grounding work must follow to regulations of each countries.



Do not connect absolutely grounding wire with gus tube.
*Danger of death and serious injury.

LOCATION OF INSTALLATION



Do not install the unit at where explosives and/or combustibles are kept or will be used.

*The unit is made of metal. So corrosion, rust and electrical spark may cause explosion and/or fire.



(EXPLOSIVES)



(COMBUSTIBLES)
(INGITIBLES)
(CAMBUSTIBLE GUS)



(OXIDES)

Matsunaga

No. 957PL1A



WARNING



Fix the unit to the floor, pillar and wall in order not to fall down or move by earthquake.
*Falling down may cause injury.



Do not put anything and step on the unit.
*Radiation will be affected and the inside temperature will rise.
*Objects on the unit may be scorched by heat.
*Top cover of the unit may be curved by heat.



Do not disassemble, repair and/or reconstruct the unit recklessly.
*It may cause malfunction, trouble and/or burnt.



Do not touch where this mark is sealed on at checking inside of the unit, even if the input power is turned off.
*It may cause death or serious injury by electric shock.



Do not touch the terminals and studs during operation, which this mark is sealed on.
*It may cause death or serious injury by electric shock.

TRANSPORTATION & MOVE



Avoid rain and water-drops.
*It may cause electric shock and malfunction.



Do not put down sideways. Fix the unit carefully in order not to fall down by vibration.
*It may cause damages of inside components and malfunction.



Hang up the unit, using all hanger-bolts.
*It may cause serious injury by drop of the unit.



CARE



Do not change carelessly adjusting resistors on P.C. Board. Because the values are already set properly at our factory.
*It may cause damages of your equipments, unstable functions and/or troubles of the unit.



Do not do a insulating resistance test between input(& output) and E-terminal(Frame). The test for insulated products must be done only between Input and Output.
*It may cause damage and/or malfunction of the unit.



In case of meggar test, use instrument of DC500V.
*It may cause damage and/or malfunction of P.C. Board.



Do not keep the unit under the below mentioned locations for temporary storage or unused for a certain period.

- Where water-drops come into.
- Where relative humidity rises more than 85%.
- Where ambient temp. drops under-10°C (or makes dews) and rise over+50°C.
- Where there have gas and oxide objects, which makes corrosion of metal.
- Where there have dust, metal powder and electric conductive powder.
- Where receives vibrations and shocks.
- Where sun-shine comes into directly.

*These may cause electric shock, injury, fire, malfunction of the unit.



(MAINTENANCE & ROUTIN CHECK)
Turn off the main switch(input) in case of maintenance and rutin check.

Do not touch your hand and body to electric conductive part of the unit.
*It may cause electric shock and injury.
■Inside components will be emaciated in extremely rapid, if maintenance and rutin check are not effected. Our warranty excludes some troubles caused by lack of maintenance or rutin check.



(ACCIDENT AT OPERATION)
Turn off the main switch and solve causes. Restart the operation.
*It may cause electric shock, damage and/or fire.

取扱説明書 OPERATING INSTRUCTIONS

- 添付の標準品取扱説明書を、御参照下さい。
Please refer to the attached operating instructions for standard articles.
- 下記の項目以外の説明は、標準品取扱説明書と同じです。
Descriptions of items other than the following, are the same as those listed in the operating instructions for standard articles.

3. 仕様 Specifications

4GH-18363A による。

4-4. 保護回路 Protection

- 1) T1, T4, L1, L2, L3, L4にサーモスタットを取付け、温度が120℃以上になった時、入力ブレーカの引き外しコイルを動作させ遮断します。
This unit is mounted thermostats on T1, T4, L1, L2, L3 and L4 as to trip the input circuit breaker, when temperature is over 120℃.
- 2) 入力電圧が180Vを外れると、低電圧保護回路が動作し出力の電磁接触器を遮断します。また、入力電圧が180V以上を約5秒間継続すると、自動的に復帰します。
If the input voltage of the regulator deviates by below 180V the low voltage protection circuit intervenes and open the magnetic switch.
And when input voltage resumes within below 180V at continue approx. 5 seconds of the magnetic switch is automatically closed.

5. 外観・計装品 Panel Features

3GM-7076A による。

9. 入力電源容量 Power Supply


本装置への入力電源容量は、最大値で定格出力容量の1.97倍となります。したがって、入力電源および入力側配線材は、この最大容量を満足する物を使用して下さい。
The power input may reach 1.97 times the rated power output of the regulator. When selecting the power source and connecting cables between the power source and the regulator, keep this in mind.

1.4. 主回路 Circuit Diagram

4GH-18364 による。

1.5. 配線材と電圧降下 Recommended Connecting Cables

	端子寸法 Terminals and stud bolts	配線材径 Cross section of cable(mm ²)	電圧降下 Voltage drop(v/m)
入力側 Input side	M5	5.5	0.174
出力側 Output side	M5	5.5	0.194
接地 Grounding	M5	2.0	---

変更事項 REVISIONS			材質 MATERIALS	処理 TREATMENT	数量 QUANTITY	名称 TITLE	取扱説明書 OPERATING INSTRUCTIONS
日付 DATE	内容 CONTENTS	担当 REV.	第三角法 THIRD ANGLE PROJECTION	単位 UNITS	尺度 SCALE	型名 MODEL	TSA-1030-CJ
				%	/		
			承認 APPROVED BY	検図 CHECKED BY	製図 DRAWN BY	設計 DESIGNED BY	図番 DRAWING No.
			佃		大金	大金	4GH-18626
			年月日 ISSUED	2006 . 1 . 24			

サイリスタ絶縁型定電圧電源装置仕様
AC AUTOMATIC VOLTAGE REGULATOR SPECIFICATIONS (ISOLATED THYRISTOR TYPE)

型名 MODEL	TSA-1030-CJ		
冷却方式 COOLING SYSTEM	乾式自冷式 AIR-COOLED TYPE		
相数 PHASE	1 φ SINGLE PHASE		
定格周波数 RATED FREQUENCY	50/60 Hz (切換式) (CHANGE-OVER)		
周波数変動範囲 FREQUENCY VARIATION	± 2 Hz		
定格出力容量 RATED CAPACITY	3 kVA		
定格入力電圧 RATED INPUT VOLTAGE	AC 240 V		
入力電圧変動範囲 INPUT VOLTAGE VARIATION	AC 180 V ~ 260 V		
定格出力電圧 RATED OUTPUT VOLTAGE	AC 100 V		
定電圧精度 ACCURACY	± 1.5 % 以内 WITHIN ± 1.5 %		
出力電圧調整範囲 ADJUSTABLE RANGE OF OUTPUT VOLTAGE	± 3 %		
負荷変動範囲 LOAD VARIATION	0~100 %		
負荷力率 LOAD POWER FACTOR	100 %		
波形歪率 DISTORTION FACTOR	5 % 以下 (発生歪) LESS THAN 5 % INTRODUCED		
応答時間 RESPONSE TIME	秒 以内 (入力電圧 15% 急変時) 0.08 sec OR LESS (15% VOLTAGE VARIATION)		
効 率 EFFICIENCY	85 % OR MORE (入力 180 V 定格負荷時) (INPUT 180 V IN RATED LOAD)		
力 率 POWER FACTOR	73 % OR MORE (入力 180 V 定格負荷時) (INPUT 180 V IN RATED LOAD)		
絶縁抵抗 INSULATION RESISTANCE	5 MΩ MORE THAN (DC 500V 効-) (DC 500V MEGGER)		
絶縁耐圧 DIELECTRIC STRENGTH	AC 1500 V (1分間) (1MIN)		
温度上昇 TEMPERATURE RISING	B 種 70 °C 以下 (温度計法) CLASS B, 70 °C OR LESS (THERMOMETER METHOD)		
周囲温度 AMBIENT TEMPERATURE	0°C ~ 40°C		
相対湿度 RELATIVE HUMIDITY	30 % ~ 85 %		
塗装色 PAINTING COLOR	正面 FRONT PANEL: 2.5Y9/1	レザー トン LEATHER-TONE	(参考: 淡黄色) (REFERENCE: CREAM)
	外装 OUTSIDE: 2.5PB3.5/10	レザー トン LEATHER-TONE	(参考: 青色) (REFERENCE: BLUE)

重量 WEIGHT 約 APPROX. 180 kg

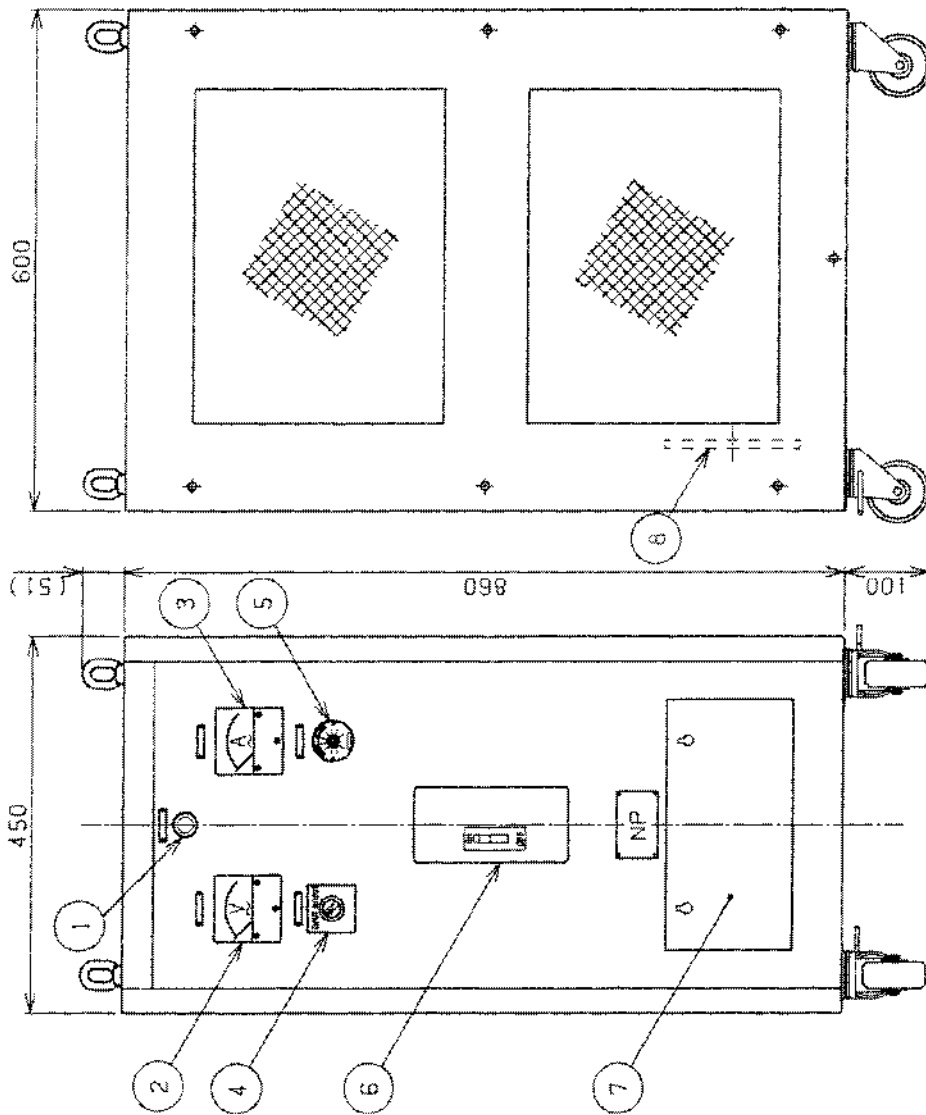
保護回路 Protection

1. T1, T4, L1, L2, L3, L4にサーモスタットを取付け、温度が120°C以上になった時、入力ブレーカの引き外しコイルを動作させ遮断します。
This unit mounted thermostats on T1, T4, L1, L2, L3 and L4 as to trip the input circuit breaker, when temperature is over 120°C.
2. 入力電圧が180Vを外れると、低電圧保護回路が動作し出力の電磁接触器を遮断します。また、入力電圧が180V以上を約5秒間継続すると自動的に復帰します。
If the input voltage of regurator deviates by below 180V the low voltage protection circuit intervenes and open the magnetic switch.
And when input vottage resumes within below 180V at continue approx. 5seconds of the magnetic switch is automatically closed.

外形図 OUTLINE DRAWING 図番 DRAWING No. 3GM-7076A
回路図 CIRCUIT DIAGRAM 図番 DRAWING No. 4GH-18364

変更事項 REVISIONS			材質 MATERIALS	処理 TREATMENT	数量 QUANTITY	名称 TITLE	仕様事項書 SPECIFICATIONS
日付 DATE	内容 CONTENTS	担当 REV	第三角法 THIRD ANGLE PROJECTION	単位 UNITS %	尺度 SCALE /	型名 MODEL	TSA-1030-CJ
06.1.23	A 整備	大金	承認 APPROVED BY	検図 CHECKED BY	製図 DRAWN BY	図番 DRAWING No.	4GH-18363A
	B.		佃		大金		
	C.				大金		
	D.				大金		
	E.		年月日 ISSUED	Oct. . 30 . 2004			

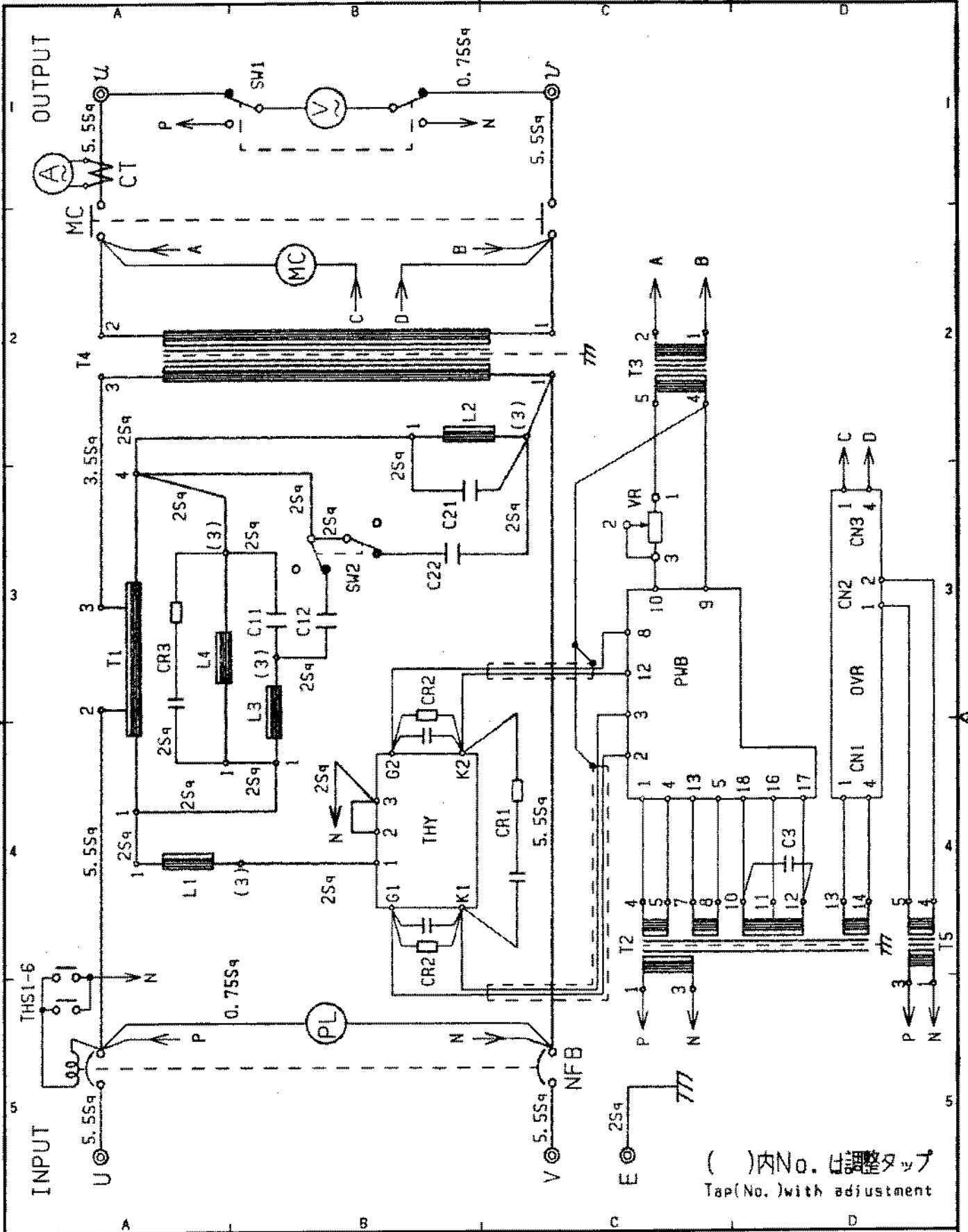




No.	名称 NAME	小銘板表示 INDICATION
1	表示灯 PILOT LAMP	SOURCE
2	電圧計 VOLTMETER	IN&OUT VOLTAGE
3	電流計 AMMETER	OUTPUT CURRENT
4	電圧切換スイッチ VOLTAGE TRANSFER SWITCH	V-METER TRANSFER
5	出力電圧調整器 OUTPUT VOLTAGE ADJUSTOR	VOLTAGE ADJUSTOR
6	サーキットブレーカ CIRCUIT BREAKER	
7	端子板カバー COVER OF THE TERMINALS PLATE	
8	端子板 TERMINALS PLATE	
9		
10		

F 変更事項 REVISIONS		G 材料 MATERIALS		H 外形 OUTLINE DRAWING	
日付 DATE	内容 CONTENTS	種別 TREATMENT	数量 QUANTITY	名称 TITLE	型番 MODEL
1.1.31	A ~ TER → -TOR 欠陥	単位 UNITS	尺度 SCALE		
B		%	1/6		
C		検出 CHECKED BY	設計 DESIGNER		
D		Y. Kobayashi	H. Sawada		
E		年月日 ISSUED	数量 QUANTITY	図番 DRAWING NO.	3GM-7076A
			28		
			1985		

新松永製作所
Matsunaga Manufacturing Co., Ltd.



変更事項 REVISIONS			材質 MATERIALS	処理 TREATMENT	数量 QUANTITY	名称 TITLE	回路図 CIRCUI T DIAGRAM
日付 DATE	内容 CONTENTS	担当者 REV	第三角法 THIRD ANGLE PROJECTION	単位 UNITS	尺度 SCALE	型号 MODEL	
A.							
B.							
C.			承認 APPROVED BY	検図 CHECKED BY	製図 DRAWN BY	設計 DESIGNED BY	図番 DRAWING No.
D.			J. Iukuda		J. Ohgane	J. Ohgane	4GH-18364
E.			年月日 ISSUED	Oct.,	29.	2004	株式会社 松永製作所 Matsunaga Manufacturing Co., Ltd.

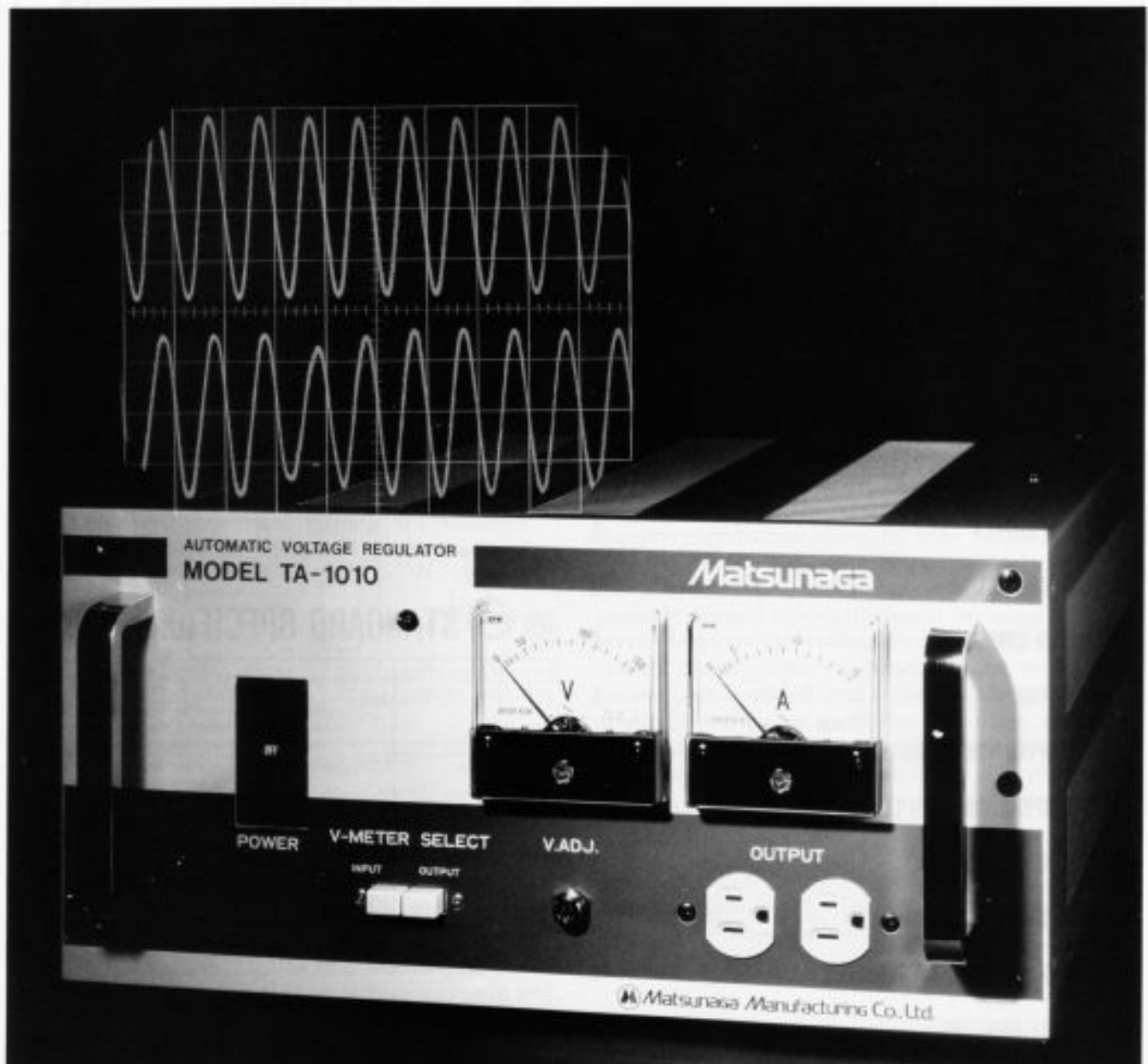


AVR
TA-TSA

AUTOMATIC VOLTAGE REGULATORS
THYRISTOR TYPE

OPERATING INSTRUCTIONS

- Make sure to read this operating instructions before using this equipment. And keep this manual with much care in order to facilitate the routine check-up and avoid the unexpected malfunction of the equipment.



 **Matsunaga Manufacturing Co., Ltd.**

AUTOMATIC VOLTAGE REGULATORS/TA-TSA

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1 DESCRIPTION

The Series TA and TSA are non-mechanical, thyristor type automatic voltage regulators. When the output voltage of the regulator deviates from the rated value due to variations of the input voltage or the load, the deviation voltage is detected by a high-sensitivity RMS converter IC. The deviation voltage is amplified, converted into control signal and fed to the thyristor circuit. The thyristor circuit restores the output voltage to the rated value.

The RMS converter IC incorporated in the detector circuit improves both reliability and durability. The Proportional and Integral (PI) control system eliminates both the steady-state deviation and the overshooting of the output voltage. The drift of the output voltage at the initial transient is also minimized and the temperature coefficient is very small.

The Series TSA is isolated and electrostatically shielded (between the primary and secondary sides).

2 FEATURES

- RMS detection.
- High accuracy and high response speed.
- Low distortion. The pulse-shaped switching distortion introduced in the thyristor circuit is filtered.
- High efficiency and a compact and lightweight construction.
- Even if the output terminals are shorted, the thyristor is not damaged.
- Special circuit is provided to prevent the malfunction of the thyristor.
- Maintenance free.
- Series TSA is isolated and electrostatically shielded (between the primary and secondary sides). The noise contained in the line voltage is reduced.

3 STANDARD SPECIFICATIONS

Input and output voltage	1 ϕ 100V, 1 ϕ 200V, 3 ϕ 200V
Input voltage variation	-15% to +15%
Frequency	48Hz to 52Hz or 58Hz to 62Hz (models for 1 ϕ , 10kVA and downwards are compatible with both 50Hz and 60Hz)
Output voltage accuracy	Within $\pm 0.4\%$ for Series TA Within $\pm 1\%$ for Series TSA
Output voltage line adjustment	$\pm 3\%$ of the rated value
Load variation	0 to 100%
Waveform distortion	Less than 3% introduce
Response time	Within 0.08 to 0.15 sec. (against 15% input voltage variation)
Efficiency	More than 85% for models for 2kVA and downwards More than 90% for models for 3kVA and upwards (at the lowest input voltage and under rated load)
Power factor	More than 0.75 for models for 2kVA and downwards More than 0.8 for models for 3kVA and upwards (at the lowest input voltage and under rated load)
Ambient temperature	0 to 40°C

Relative humidity	30 to 85%
Temperature rise	Less than 50°C(under rated load for class A insulation) Less than 70°C(under rated load for class B insulation) (at hottest point by thermometer)
Insulation resistance	More than 10 MΩ (small capacity units), More than 3 MΩ (large capacity units), measured at DC 500V
Dielectric strength	Tested at 1500 VAC for 1 min.

*Unbalance of the loads is allowed up to 20% for the models for three-phase.

- With respect to the models with less than 2kVA, Efficiency should be over 85% and power factor should be 0.75 as standards.
- In reference to the single phase models with less than 10kVA frequency 50Hz or 60Hz is compatible. The other models are manufactured as the special type for only 50Hz or 60Hz.

4 CIRCUIT DESCRIPTION

Fig. 1 is the block diagram of the Series TA and TSA. In the case of the models for three-phase, Fig. 1 shows the block diagram for each phase.

- Deviation voltage detector and phase control circuit
The deviation voltage is detected and fed to the phase control circuit through the amplifier. The phase control circuit controls the thyristor circuit to restore the output voltage.
- Thyristor circuit
Controlled by the signal from the phase control circuit, maintain the output voltage of the regulator constant by varying the phase angle of the thyristor.
- Waveform compensating circuit
The harmonic distortion introduced in the thyristor circuit is eliminated.

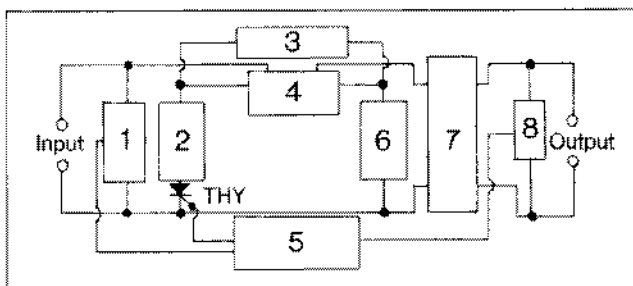


Fig. 1 Block diagram

- | | |
|--|--|
| 1: Control transformer | 6: Parallel reactor |
| 2: Series reactor | 7: Isolated and electrostatically shielded transformer (Series TSA only) |
| 3: Waveform compensating circuit | 8: Detector |
| 4: Control reactor | THY: Thyristor |
| 5: Deviation voltage amplifier and phase control circuit | |

4-1 DEVIATION VOLTAGE DETECTOR AND PHASE CONTROL CIRCUIT

The block diagram of these circuits are shown in Fig. 2.

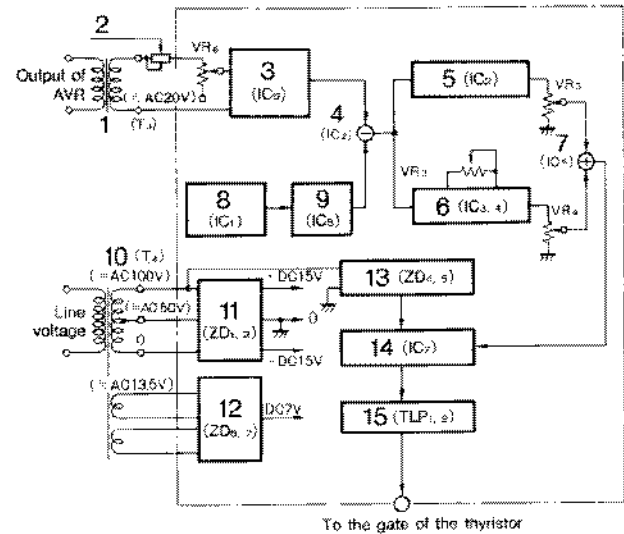


Fig. 2 Block diagram of the deviation voltage detector and the phase control circuit

(Main elements of each section are given in the parenthesis.)

- | | |
|-------------------------------------|------------------------------------|
| 1: Detecting transformer | 9: Reference voltage generator |
| 2: Output voltage adjuster | 10: Control transformer |
| 3: RMS converter circuit | 11: Stabilized DC power supply |
| 4: Substractor | 12: Stabilized DC power supply |
| 5: Proportional (P) control circuit | 13: Synchronizing signal generator |
| 6: Integral (I) control circuit | 14: Phase control circuit |
| 7: Adder | 15: Photo-coupler |
| 8: Soft start circuit | |

The output voltage of the regulator is dropped to about 20V by the detecting transformer and fed to the RMS converter circuit. The RMS converter generates the DC voltage proportional to the root mean square (effective value) of the AC input voltage. Then, the substractor subtract the reference voltage generated in the reference voltage generator from the output of the RMS converter. Using the output of the substractor, the proportional and the integral control circuits generate control signals (It should be noted that IC₂ serves both as the substractor and the proportional control circuit). Both the outputs of the two control circuits are amplified and added in the adder. The phase control circuit generates the trigger signal for the thyristor, using the outputs of the adder and the synchronizing signal generator. Finally, the trigger signal is fed to the gate of the thyristor through the isolating photo coupler.

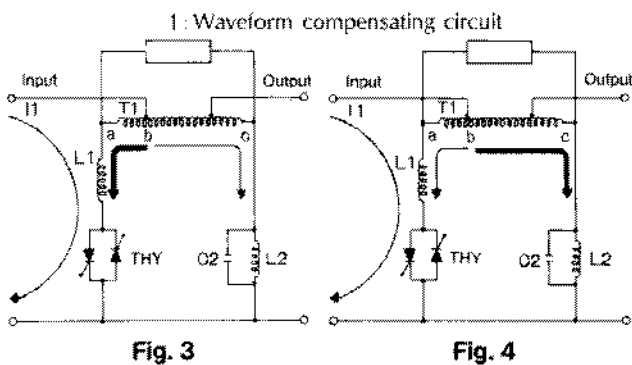
The PI (Proportional and Integral) control system improves the accuracy of the output voltage of the regulator considerably. The soft start circuit restricts the output voltage for a short time after the regulator is switched on.

AUTOMATIC VOLTAGE REGULATORS/TA-TSA

4-2 THYRISTOR CIRCUIT

When the output voltage becomes lower than the rated value, the phase angle of the thyristor (THY) becomes smaller. Therefore, the impedance of the series reactor circuit (L_1 and THY) decreases and current flows mainly through L_1 . In this case, power input is mainly supplied between a and b of the control reactor (T_1) and T_1 serves as a step-up transformer (Fig. 3).

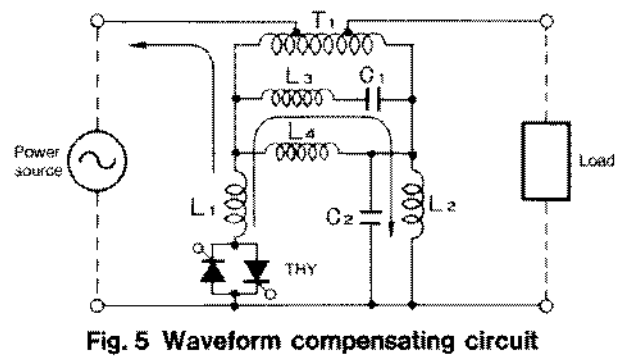
When the output voltage exceeds the rated value, the phase angle of THY becomes larger and the impedance of the series reactor circuit (L_1 and THY) increases. Therefore, current flows mainly through the parallel reactor (L_2) and power input is mainly supplied between b and c of T_1 . T_1 serves as a step-down transformer (Fig. 4).



increases. Therefore, current flows mainly through the parallel reactor (L_2) and power input is mainly supplied between b and c of T_1 . T_1 serves as a step-down transformer (Fig. 4).

4-3 WAVEFORM COMPENSATING CIRCUIT

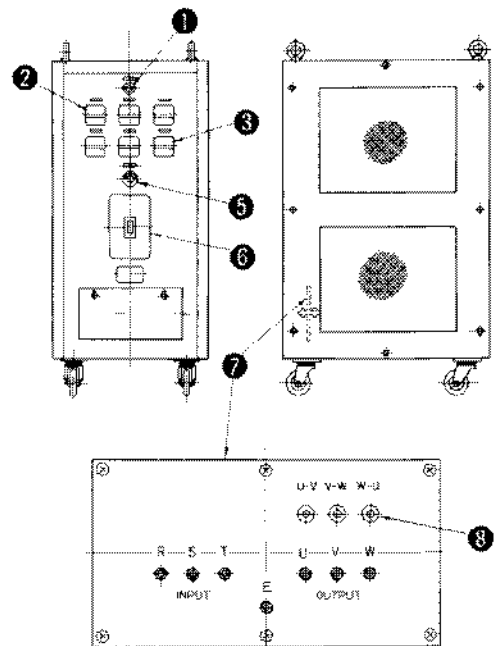
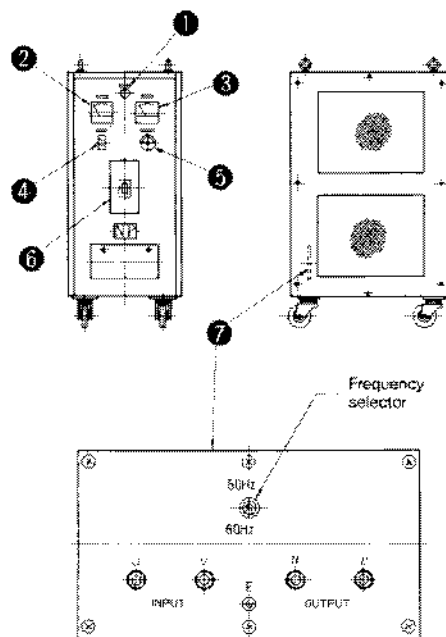
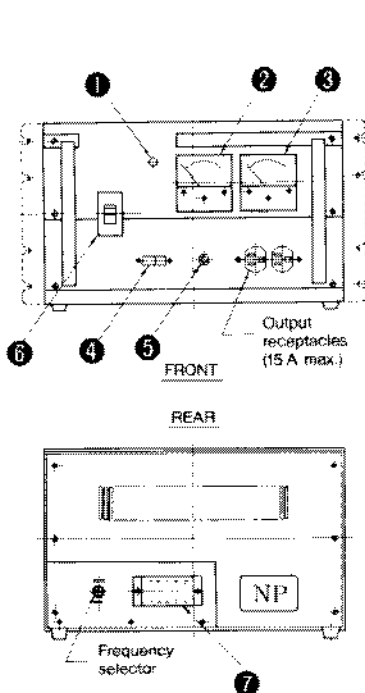
The output of the thyristor circuit contains odd harmonics. These harmonics are eliminated with the aid of the resonance circuit comprised of reactors (L_3 , L_4) and a capacitor (C_1) and with the aid of a capacitor (C_2) connected in parallel to L_2 (Fig. 5).



5 PANEL FEATURES

- ① Pilot lamp: Lights up when the power switch (no-fuse breaker) is turned on.
- ② Voltmeter: Indicates the output voltage. In the case

of the models for single-phase, input voltage can also be monitored by turning the voltmeter function switch.



- ③ **Ammeter:** Indicates the output current.
- ④ **Voltmeter function switch:** For the models for single-phase only. Either the output or input voltage can be monitored by turning this switch.
- ⑤ **Output voltage adjustor:** The output voltage can be raised or lowered by $\pm 3\%$ by turning this dial clockwise or counterclockwise.
- ⑥ **Power switch (no-fuse breaker)**
- ⑦ **Input and output terminals:** Input terminals are marked, "U", and "V" (single-phase), "R", "S" and "T" (three-phase). Output terminals are marked, "u" and "v" (single-phase), "U", "V" and "W" (three-phase). The grounding terminal is marked "E".
- ⑧ **Line voltage fine adjustors:** For the models for three-phase only. The line voltages can be adjusted when the regulator is at no load or connected to a balanced load. When adjusting the line voltages, disconnect the balanced load.

6 DELIVERY INSPECTION

When received, the regulator should be checked for the followings:

- Correct model number.
- Damages in transit.
- Loosen screws or terminals.

If any trouble is discovered, please inform us or our dealer.

7 STORAGE OR TRANSIT

When the regulator is temporarily stored or unused for long periods, care should be taken as follows.

7-1 STORAGE

Environmental requirements for storing the regulator are as follows.

- Do not expose the regulator to rain, water or moisture.
- Keep the regulator free from corrosive gases or liquids, dust or iron filings.
- Ambient temperature should be between -10°C and $+50^{\circ}\text{C}$.
- Store the regulator on a vibration-free floor.

7-2 INSULATION RESISTANCE TEST

If the regulator has been stored for a long time it should be tested for insulation resistance before using.

After turning the power switch ON, measure the insulation resistances between the input/output terminals and the grounding terminal using an insulation resistance tester (Megger). In the case of the Series TSA, the insulation resistance between the input and output terminals should also be measured.

7-3 TRANSIT

Avoid excessive vibration or shock when transporting the regulator.

8 INSTALLATION

8-1 ENVIRONMENTAL REQUIREMENTS

See "7-1. Storage". For the ambient temperature, see "3. Standard Specifications".

8-2 LOCATION

Make sure the regulator has enough cooling space above and around it (see Figs. 9 and 10).

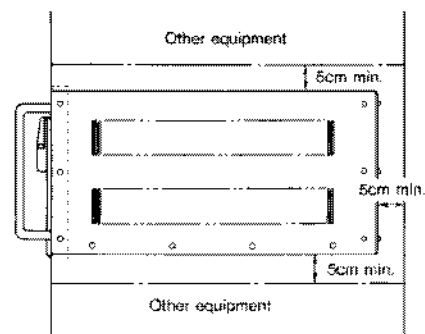
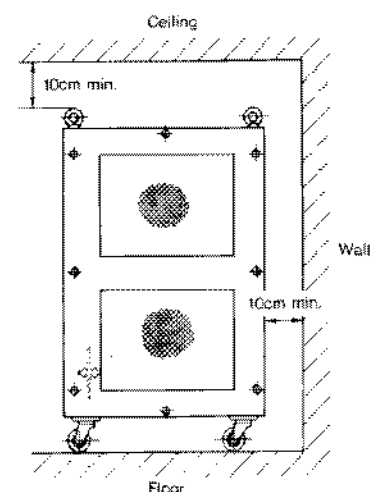


Fig. 9 Built-in type



Both sides by 5cm min. apart from walls.

Fig. 10 Stand-alone type

9 POWER SUPPLY

The power input may reach 1.65 times the rated power output of the regulator (at full load, at the lowest input voltage, i.e., -15% , efficiency 90% and power factor 0.8). When selecting the power source and connecting cables between the power source and the regulator, keep this in mind.

10 LOAD CONNECTION

When the load is distant from the regulator, take care of the voltage drop which occurs in the cables.

Use of thermoplastic-covered wires for 600 VAC or cabtyre (tough-rubber sheathed) cables is recommended. When selecting the cable, crimp-style terminals and stud bolts, please refer to Table, Section 15.

11 GROUND CONNECTION

The grounding cable should be made as short as possible. Select the grounding cable referring to Table, Section 15.

Never connect the grounding cable to the grounding rod to which heavy current equipments are already connected.

12 OPERATION

After the connection, check for the followings:

- Check the connections between the power source and the regulator, between the regulator and the load and between the regulator and the grounding rod. In the case of the models for three-phase, care should also be taken to the polarity of the power source and the load.
- Check for loosen bolts at the terminals.
- Check whether the frequency selector is turned to the appropriate position.
- Check the input voltage (for three-phase, check the line voltages of the input).
- Make sure all the environmental requirements are satisfied.

12-1 OPERATION AT NO LOAD

- After the above-mentioned checks have been completed, turn the power switch of the load off. When a power switch is not provided to the load, disconnect it.

- Turn the power switch (no-fuse breaker) of the regulator ON. The pilot lamp lights up and the instruments indicate the input or output voltage and the output current.
- When the output voltage deviates from the rated value, proceed as follows:
 - a. Wait at least 20 to 30 seconds after the regulator has been switched on.
 - b. Adjust the output voltage by turning the output voltage adjuster. For models for three-phase, adjust the line voltages of the output by turning the line voltage fine adjusters.

12-2 OPERATION WITH LOAD

After the output voltage is adjusted, turn the regulator OFF and connect the load again. Then, switch the regulator ON again.

Check the followings:

- Make sure the output voltage of the regulator is stabilized.
- Make sure the output current is less than the rated maximum current.
- Make sure no unusual noise is heard.

13 ROUTINE INSPECTION

The following inspection is recommended.

(1) At least every month

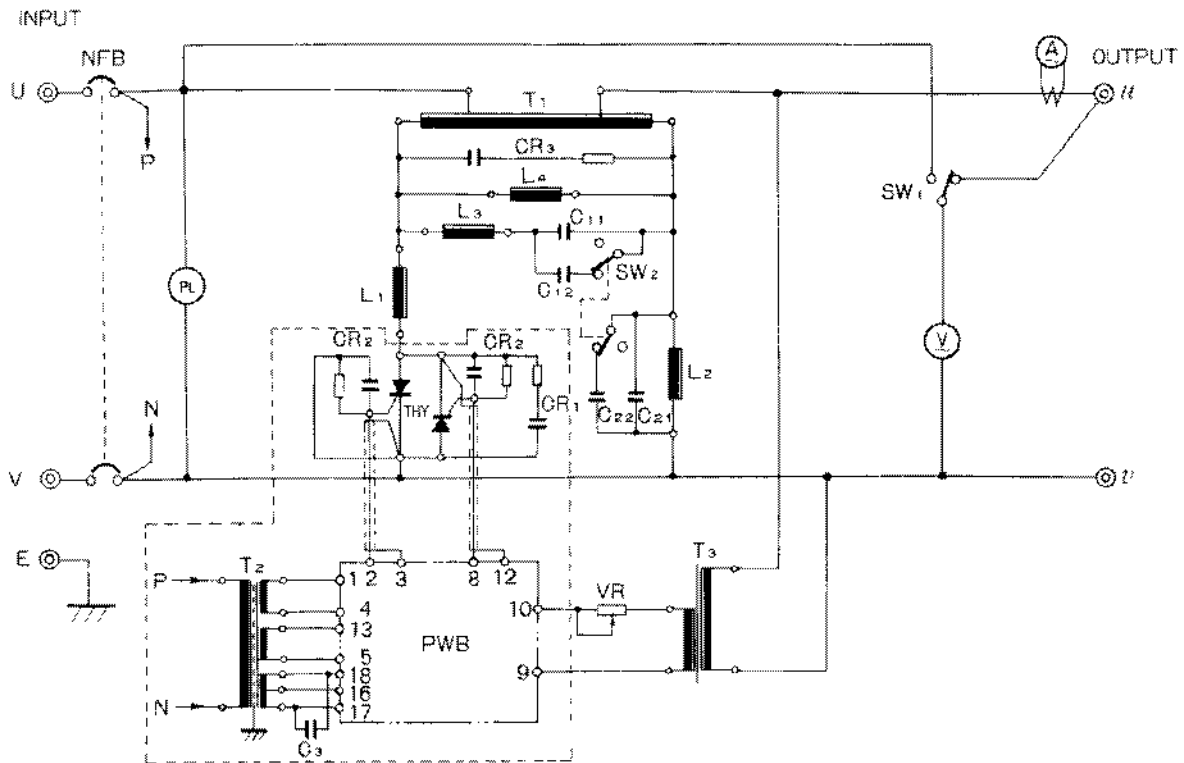
- Check whether the output voltage is stable.
- Check whether the output current is less than the rated maximum value.
- Check for unusual noise.
- Check for unusual smell.

(2) Every three months to every year

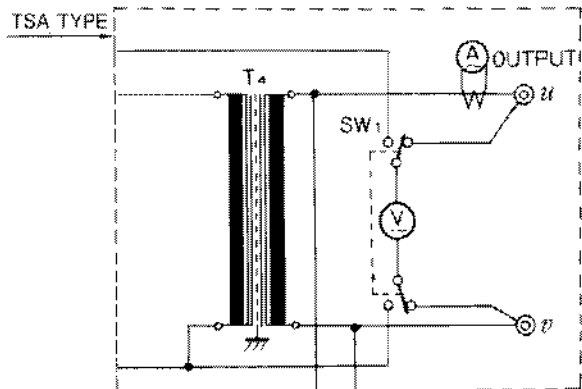
- Check the cables for temperature rise.
- Check the terminals for loosen bolts.
- Check the inside of the regulator for dust, oily stains.
- Check the transformers and reactors for change of color.

14 MAIN CIRCUIT DIAGRAM

MODELS FOR SINGLE-PHASE (TA AND TSA)

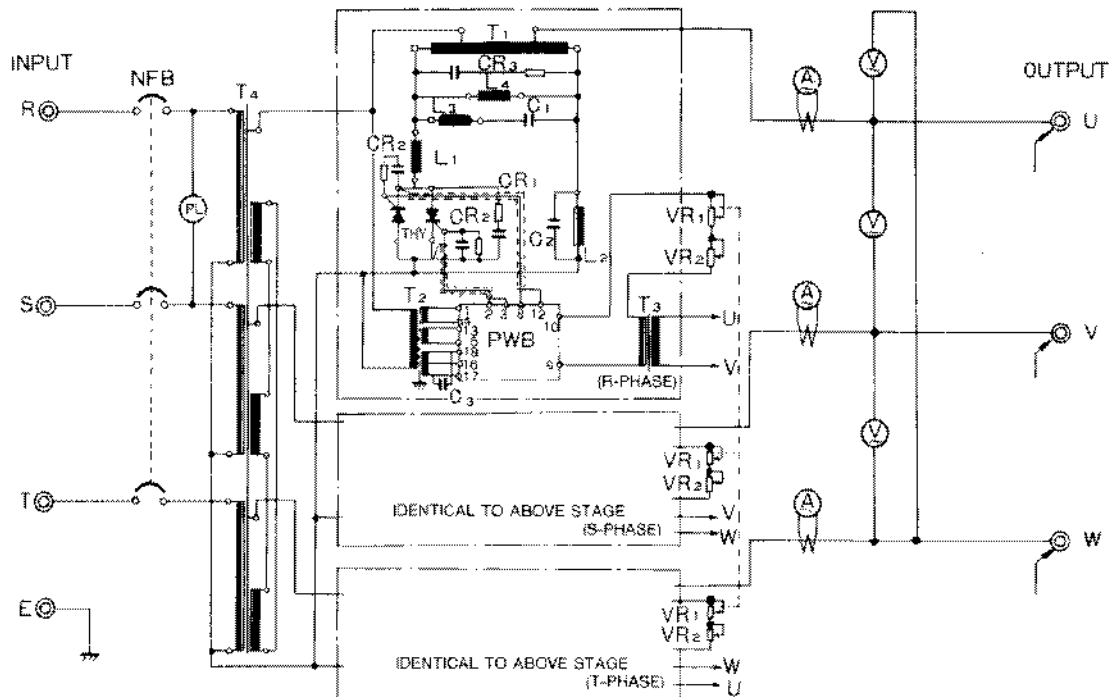


- T₁: Control reactor
- T₂: Control transformer
- T₃: Detecting transformer
- T₄: Main transformer
(isolated and electrostatically shielded)
- L₁: Series reactor
- L₂: Parallel reactor
- L₃, L₄: Waveform compensating reactors
- THY: Thyristor
- C₁₁, C₁₂, C₂₁, C₂₂, C₃:
Waveform compensating capacitors
- CR₁, CR₂:
Protection circuits
- CR₃: Waveform compensating circuit
- PWB: Deviation voltage detector and phase control circuit (Control circuit board)
- VR: Output voltage adjustor
- NFB: Power switch (No-fuse breaker)
- PL: Pilot lamp
- V: Voltmeter
- A: Ammeter
- SW₁: Voltmeter function switch
- SW₂: Frequency selector

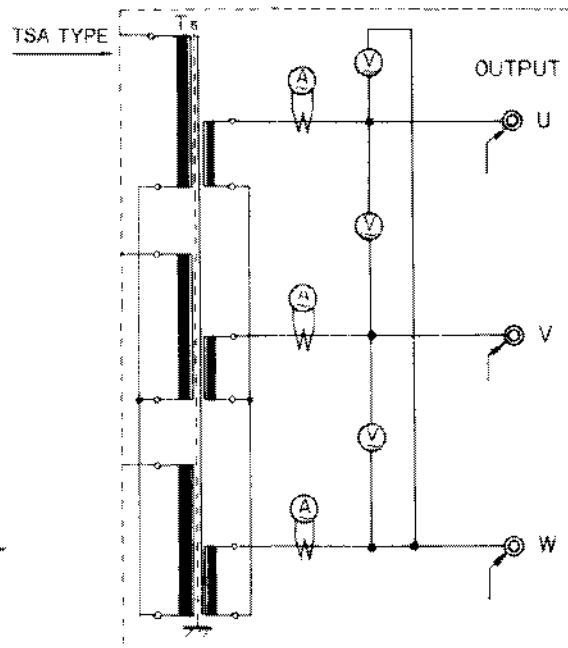


MAIN CIRCUIT DIAGRAM

MODELS FOR THREE-PHASE (TA AND TSA)



- T₁:** Control reactor
- T₂:** Control transformer
- T₃:** Detecting transformer
- T₄:** Input transformer
- T₅:** Main transformer
(isolated and electrostatically shielded)
- L₁:** Series reactor
- L₂:** Parallel reactor
- L₃, L₄:** Waveform compensating reactors
- THY:** Thyristor
- C₁, C₂, C₃:**
Waveform compensating capacitors
- CR₁, CR₂:**
Protection circuits
- CR₃:** Waveform compensating circuit
- PWB:** Deviation voltage detector and phase control circuit (Control circuit board)
- VR₁:** Output voltage adjustor
- VR₂:** Line voltage fine adjustor
- NFB:** Power switch (No-fuse breaker)
- PL:** Pilot lamp
- V:** Voltmeter
- A:** Ammeter



15 WIRING MATERIALS AND VOLTAGE DROP TABLE

D: diameter dV: Voltage drop(V/m)
De: diameter of the grounding cable

Model	Cable for input side				Cable for output side				De	Terminal & bolts		
	D	dV	D	dV	D	dV	D	dV		Input	Output	Grounding
TA-105	1.6φ	0.163	5.5mm ²	0.959	1.6φ	0.089	2.0φ	0.057	2.0mm ²	M 4	M 4	M 4
TA-1010	2.0φ	0.209	8	0.082	1.6φ	0.178	5.5mm ²	0.065	2.0	M 4	M 4	M 4
TA-1015	5.5mm ²	0.179	14	0.071	2.0φ	0.170	8	0.087	2.0	M 4	M 4	M 4
TA-1020	8	0.164	22	0.060	5.5mm ²	0.130	14	0.051	3.5	M 5	M 5	M 5
TA-1030	14	0.125	30	0.058	8	0.134	22	0.049	3.5	M 5	M 5	M 5
TA-1050	22	0.122	50	0.058	14	0.125	30	0.060	5.5	M10	M 8	M 6
TA-1075	30	0.146	80	0.055	22	0.122	50	0.054	14	M12	M10	M 8
TA-10100	38	0.153	100	0.059	22	0.162	60	0.060	14	M12	M10	M 8
TA-10150	50	0.175	150	0.059	30	0.178	100	0.054	22	M16	M12	M10
TA-10200	60	0.194	200	0.059	38	0.188	125	0.057	22	50×6t	M16	M10
TA-10300	100	0.175	250	0.070	60	0.178	150	0.072	38	75×6t	50×6t	M12
TA-10400	150	0.135	325	0.072	80	0.178	200	0.072	50	100×6t	50×6t	M12
TA-10500	200	0.146	400	0.073	100	0.178	250	0.072	60	100×6t	75×6t	M12
TA-10750	250	0.175	500	0.088	150	0.178	400	0.067	80	100×12t	100×6t	M16
TA-101000	325	0.179	900	0.065	200	0.178	500	0.072	100	150×10t	150×6t	M16
TSA-10300-2	50	0.173	150	0.059	60	0.178	150	0.072	22	50×6t	50×6t	M10
TSA-10400-2	60	0.194	200	0.059	80	0.178	200	0.072	22	50×6t	50×6t	M10
TSA-10500-2	80	0.182	250	0.059	100	0.178	250	0.072	38	75×6t	75×6t	M12
TSA-10750-2	125	0.175	325	0.067	150	0.178	400	0.067	50	75×6t	100×6t	M12
TSA-101000-2	200	0.146	400	0.073	200	0.178	500	0.072	60	100×6t	150×6t	M12
TA-205	1.6φ	0.163	5.5mm ²	0.060	1.6φ	0.089	2.0φ	0.057	2.0mm ²	M 4	M 4	M 4
TA-207.5	2.0φ	0.157	8	0.062	1.6φ	0.133	5.5mm ²	0.049	2.0	M 4	M 4	M 4
TA-2010	2.0φ	0.209	8	0.082	1.6φ	0.178	5.5	0.065	2.0	M 5	M 5	M 5
TA-2015	5.5mm ²	0.159	14	0.063	2.0φ	0.170	8	0.067	2.0	M 5	M 5	M 5
TA-2025	8	0.182	22	0.066	5.5mm ²	0.162	14	0.064	3.5	M 8	M 6	M 6
TA-2037.5	14	0.156	38	0.058	8	0.167	22	0.061	5.5	M 8	M 8	M 6
TA-2050	22	0.132	50	0.058	14	0.128	30	0.060	5.5	M10	M 8	M 6
TA-2075	30	0.146	80	0.055	22	0.122	50	0.054	14	M12	M10	M 8
TA-20100	38	0.153	100	0.059	22	0.162	60	0.060	14	M12	M10	M 8
TA-20150	50	0.173	150	0.059	30	0.178	100	0.054	22	M16	M12	M10
TA-20200	60	0.194	200	0.059	38	0.188	125	0.057	22	30×6t	M16	M10
TA-20250	80	0.182	250	0.059	50	0.178	150	0.060	38	50×6t	M16	M12
TA-20375	125	0.175	325	0.067	80	0.167	200	0.067	50	75×6t	50×6t	M12
TA-20500	200	0.146	400	0.073	100	0.178	250	0.072	60	100×6t	75×6t	M12
TA3-3	2.0φ	0.139	8mm ²	0.055	1.6φ	0.133	5.5mm ²	0.049	2.0mm ²	M 6	M 6	M 6
TA3-5	5.5mm ²	0.132	14	0.052	2.0φ	0.142	8	0.056	2.0	M 6	M 6	M 6
TA3-7.5	8	0.136	22	0.050	5.5mm ²	0.122	14	0.048	3.5	M 8	M 6	M 6
TA3-10	14	0.104	30	0.049	8	0.112	22	0.041	3.5	M 8	M 6	M 6
TA3-15	14	0.156	38	0.057	14	0.096	30	0.045	5.5	M10	M 8	M 6
TA3-20	22	0.132	60	0.049	14	0.128	38	0.047	5.5	M10	M 8	M 6
TA3-30	30	0.145	80	0.055	22	0.122	50	0.054	14	M12	M10	M 8
TA3-40	38	0.153	125	0.047	30	0.110	80	0.045	14	M12	M12	M 8
TA3-50	50	0.145	150	0.049	38	0.117	100	0.045	22	M16	M12	M10
TA3-75	60	0.182	200	0.055	38	0.176	100	0.067	22	50×6t	M16	M10
TA3-100	100	0.145	250	0.058	60	0.149	150	0.060	38	75×6t	M16	M12
TA3-150	150	0.145	325	0.067	100	0.134	250	0.054	50	100×6t	75×6t	M12
TA3-200	200	0.145	500	0.058	125	0.142	325	0.055	60	100×12t	100×6t	M12

* TSA models except the models from TSA-10300-2 type to TSA-101000-2 type apply to all the TA model.

16 TROUBLE-SHOOTING

SYMPTOM	CAUSE (S)	REMEDY
No output voltage (Voltmeter indicates zero)	Power source disconnected	Connect power source
	Power switch turned OFF	Turn power switch ON
	Loosen terminal bolts	Tighten terminal bolts
	Defective voltmeter or pilot lamp	Replace defective voltmeter or pilot lamp
Incorrect output voltage	Improper output voltage adjustment	Turn output voltage adjustor
	Input voltage too low or too high	Use regulator at rated input voltage
	Bad contact between control circuit board and its socket	Remove and refit control circuit board
	Defective control circuit board	Repair or replace defective parts
	Defective detecting transformer	Repair or replace defective parts
	Defective output voltage adjustor	Repair or replace defective parts
	Defective line voltage fine adjustor (three-phase)	Repair or replace defective parts
	Defective thyristor	Repair or replace defective parts
Hunting occurs	Line voltage of the output unbalanced	Adjust line voltages by turning line voltage fine adjustors
	Frequency selector in wrong position	Turn frequency selector to correct position
	Periodic variation of input voltage at a certain frequency (Resonance occurs)	Check variation of input voltage
	Periodic variation of load at a certain frequency (Resonance occurs)	Disconnect load and check whether hunting stops or not
	Defective control circuit board	Repair or replace defective control circuit board
Power switch (no-fuse breaker) cannot be turned ON	Defective no-fuse breaker	Replace defective no-fuse breaker
	Short circuit between output terminals or overload	Operate regulator at rated load
	Burning transformer or reactor	Replace burning transformer or reactor
Unusual hum	Loosen screws securing transformer or reactor	Tighten loosen screws
Unusual smell	Burning transformer or reactor	Replace burning transformer or reactor

For any assistance please contact our engineering division (the address is given below), and inform us of the following.
 ● Model and serial numbers ● Fault conditions (in the case of problems) ● Operating conditions

INSPECTION CERTIFICATE

We hereby certify that this product has been duly passed our quality standard.

APPROVED BY	TESTED BY



4-44, Tsunashima-nishi 5-chome, Kohoku-ku, Yokohama 223, Japan.
 Phone : Yokohama 045-542-2121 Facsimile : Yokohama 045-542-2141
 Telex : J36210 MATEX

ENGINE GENERATOR

Instruction Manual



Safety Information

1. Carefully read this operation manual and its related textbooks beforehand for proper machinery operation.
2. Properly operate the machine after understanding the technical knowledge and safety information.
3. In this operation manual, major safety instructions are ranked as follows.



Without proper operation, there is a possibility that you are killed or seriously injured.



Without proper operation, there is a possibility that you are injured, and/or there is a possibility that property is damaged.

Note: You are strictly requested to follow “Caution” instruction with an equivalent attention to “Danger”.



Shows prohibited operation.



Shows compulsory operation.

4. Keep those warning labels visible with proper maintenance.
5. In order to avoid any danger, understand emergency operation, and also prepare an emergency contact, emergency aid and a fire extinguisher.

Prohibition Items in Operation



- * No smoking! No fire! Otherwise, there is a possibility that you are injured by a fire explosion and a broken piece.
- * No liquid container on the machine! Otherwise, there is a possibility of causing a fire and suffering from an electric shock.
- * Don't step on and/or lean against the machine! Otherwise, there is a possibility that the machine falls down.
- * Don't dismantle the machine! Otherwise, there is a possibility of suffering from high-voltage electricity and heavy-weighted components.
- * Don't put a stick and/or a finger into a fan! Otherwise, there is a possibility that you are injured by turning fan.
- * Don't put a metal stick and/or a finger into an input (or output) terminal board in the machine. Otherwise, there is a possibility of suffering an electric shock.
- * Don't refueling while an engine works! Otherwise, there is a possibility that you are injured by a fire explosion and a broken piece.

Caution Items in Operation



- * Operate the machine as the operation manual and instructions. Otherwise, there is a possibility that careless operation causes an electric shock and an accident.
- * Stop the machine immediately after you recognize any extraordinary condition such as smoke and/or smell. Otherwise, there is a possibility of a fire on the machine.
- * Keep the door closed for ordinary operation. If you carelessly touch the inside, there is a possibility that you get an electric shock and get burned.

Prohibition Items in Maintenance



- * Don't inspect and don't repair the inside except for technical expert. Otherwise, there is a possibility of suffering from an electric shock, an injury and a burn, and/or there is a possibility of causing a fire on the machine.
- * Don't carry any metallic belongings (e.g., wristwatch) during maintenance work! Otherwise, there is a possibility that you get an electric shock, burned and injured.
- * Don't engage yourself to maintain the machine while electricity is applied! Confirm that the machine stops before maintenance work. There is a possibility that you get an electric shock, burned and injured.
- * Don't touch any high temperature parts such as an engine! Otherwise, there is possibility that you get burned even after an engine was stopped.
- * Use the same rating/typed genuine parts for replacement and avoid the mixture of new and old parts. Otherwise, there is a possibility of causing a fire.
- * Don't touch the machine with a wet hand! Otherwise, there is a possibility that you get an electric shock.
- * Make sure that the original manufacturer repair and replace the broken parts.
- * Don't touch the parts directly. It's dangerous!
- * Don't dismantle the machine. Otherwise, there is a possibility of causing a fire and suffering from an electric shock.

Caution Items in Maintenance



- * Don't inspect and don't repair the inside except for technical expert. Otherwise, there is a possibility of suffering from an electric shock, an injury and a burn, and/or there is a possibility of causing a fire on the machine.
- * Don't neglect the maintenance work to keep it well-conditioned. Otherwise, there is a possibility of causing a fire.
- * Don't touch any electric-recharged parts such as a battery terminal. Otherwise, there is a possibility that you get an electric shock, burned and injured.
- * Don't touch any high voltage portions on terminal boards inside the machine. Otherwise, there is a possibility that you get an electric shock, burned and injured.
- * Properly carry out the maintenance works after carefully reading the operation manual and understanding it well. There is a possibility that careless maintenance causes a burn, a serious injury, and/or causes a fire on the machine by a fire explosion and a broken piece.

Contents

Part A: Names and Labels of ENGINE GENERATOR

Part B: Operation Manual of AUTOMATIC CONTROL PANEL

Part C: Maintenance Manual of ENGINE GENERATOR

www.densei-lambda.com

Power-EX

DENSEI-LAMBDA 9126

User's Guide

1200VA/1500VA

 **DENSEI-LAMBDA**
An Invensys company

DS001-04-02

Class B EMC Statements

NOTE This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

VCCI Notice for Class B Equipment

この装置は、情報処理装置等電波障害自主規制協議会（VCCI）の基準に基づくクラス B 情報技術装置です。この装置は、家庭環境で使用することを目的としていますが、この装置がラジオやテレビジョン受信装置に近接して使用されると受信障害を引き起こすことがあります。取扱説明書に従って正しい取り扱いをしてください。

Special Symbols

The following are examples of symbols used on the UPS to alert you to important information:



RISK OF ELECTRIC SHOCK - Indicates that a risk of electric shock is present and the associated warning should be observed.



CAUTION: REFER TO OPERATOR'S MANUAL - Refer to your operator's manual for additional information, such as important operating and maintenance instructions.



This symbol indicates that you should not discard the UPS or the UPS batteries in the trash. The UPS may contain sealed, lead acid batteries. Batteries must be recycled.

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1. Summary

“Densei-Lambda 9126 - The Ultimate Online UPS !”

The Densei-Lambda 9126 uninterruptible power system (UPS) protects your sensitive electronic equipment from the most common power problems including power failures, power sags, power surges, brownouts, line noise, high voltage spikes, frequency variations, switching transients, and harmonic distortion.

Power outages can occur when you least expect it and power quality can be erratic. These power problems have the potential to corrupt critical data, destroy unsaved work sessions, and damage hardware causing hours of lost productivity and expensive repairs.

With the Densei-Lambda 9126, you can safely eliminate the effects of power disturbances and guard the integrity of your equipment. Figure 1 shows the Densei-Lambda 9126 UPS with an optional Extended Battery Module (EBM).

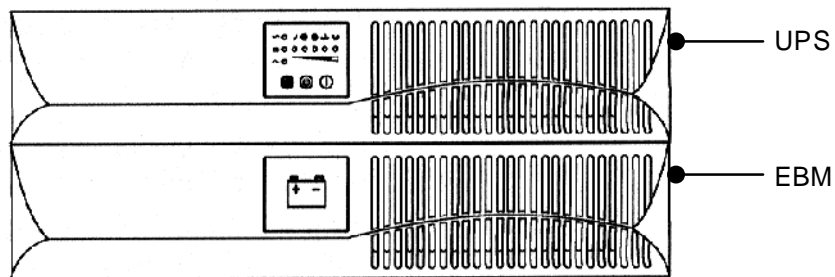


Figure 1. The Densei-Lambda 9126

Because an integral part of power protection is power management software, the Densei-Lambda 9126 comes fully equipped with a communication port, serial cable, and a CD containing for networked systems.

3.2 信号設備

The Instruction Manual of
A04-TYPE MULTI-PLAN SYSTEM
TRAFFIC SIGNAL CONTROLLER

Kyosan Electric Mfg. Co., Ltd.

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Outline

1.1 General

"A04-Type Traffic Signal Controller" is designed/produced for mainly overseas use. That makes improving its maintainability and producing it at low cost possible.

This controller have the abilities to switch the indication time in response to traffic situation by setting control pattern and to control the signals in response to traffic characteristics.

The Controller consists of Control Unit, Power Supply Unit, Lamp Switch Unit, Junction and Manual Operation Unit in terms of functions.

1.2 Configuration

Components of the Controller are shown in the following table.

Table 1.1 Component devices

Item	Device	Quantity
Main unit	Cabinet Manual Operation Unit Control Unit Power Supply Unit Lamp Switch Unit Junction	1 unit
	Pushbutton for Manual Operation	As required
Accessories	Key for main door of cabinet Key for door of Manual Operation Unit Connection code Mounting metal fixture	1 unit
Spare units	Fuse (1.6A for control power) Fuse (5A for maintenance) Setting pins (for pin board)	2 pieces 2 pieces 3pins
Attached documents	Test Report Instruction Manual Operation Manual	3 copies As required 1 copy

2. Functions and Ability

2.1 Main characteristics

(1) Improvement of Reliability

High efficiency integration of circuit and semiconductor device of power consumption controls interior evolution of heat and improves the reliability.

(2) Improvement of Maintainability

Making each Units components joint plug-in or plug-in style improves the maintainability.

(3) Maintenance of Safety

This controller maintains safety by the danger prevention (G-G protection) function for the phase.

(4) Time Setting

Pin board of panel operating unit makes the time setting easier.

2.2 Specifications

(1) Power Requirement	AC216 to 264V 50/60hz
(2) Power Consumption	approximately 30VA (excluding lamps)
(3) Ambient Temperature	-20 to +60°C
(4) Relative Humidity	40 to 90%
(5) Insulation Resistance	Between AC input terminals and Cabinet $\geq 10M\Omega$ or more at DC500V (with arrester, etc., disconnected)
(6) Insulation Voltage	Between AC input terminals and Cabinet $\geq AC 1000V$ 1 minute(with arrester, etc., disconnected)
(7) Shape	400 (W) \times 800 (H) \times 300(L) mm
(8) Weight	approximately 70kg

2.3 Main Operations

2.3.1 Flashing Operation

Yellow signal in the major road side and red signal in the minor road side flash alternately. During Flashing Operation, Pedestrian Signal Lamps and Arrow Mark Lamps go out.

Flashing Operation works in the following cases:

- When the time was set by Time Switch.(pattern flashing)
- When the Flashing Switch on the Control Unit Panel is turned "ON". (manual flashing)
- When the indication time becomes abnormally long.(abnormal flashing)
- When green signals are indicated at the same time for crossing traffic flows.(abnormal flashing)

2.3.2 Manual Operation

When the Operation Switch in the Manual Operation Unit is set at "Manual," a signal indication is advanced by one step every time the Pushbutton for Manual Operation is pressed. Unless it is pressed, the indication in a current step can be continued.

2.3.3. Multi-Plan Operation

This Operation executes three kind of patterns different in indication time of specified steps (a maximum of 5 steps) in advance.

2.3.4. Regular Cycle Operation

This Operation repeats the specified pattern all day. Changeover of a pattern is controlled by the Pattern Switch on the Control Unit Panel. When Time Switch power is turned OFF or time table is not set, pattern1 (P1) takes Regular Cycle Operation.

2.4 Function and Ability of Each Units

2.4.1 Control Unit

This Unit consists of MCU Card, PDU Card and Time Switch. It displays and designates each Operation, and controls the lamp color and each Operation works like Figure 2.1 Operation flow according to the position of switch and signal situation.

(1) Indication function

Operation and control situation of the Controller is displayed on the monitor by the following pilot lamps.

- ① Step(1-16) Pilot Lamps
- ② Clock Pilot Lamp (CLOCK)
- ③ Abnormal Pilot Lamps (G-G-FAIL)
- ④ Manual Flashing Operation Pilot Lamp (FL)
- ⑤ Running Pattern Pilot Lamps (P1, P2, P3, F)

(2) Initial all red indication

When the main power is turned ON, the power return after the power cut and operating Reset Button, starts normal Operation with first step after displaying red signal for 5 seconds to all phases. However when Flashing Switch is set to "ON", not performing all red display in first stage, immediately starts Flashing Operation.

(3) Operation in abnormal condition

- ① When green signal lamps are indicated at the same time for crossing traffic flows, the green signal lamps are once completely turned OFF in any operation mode, and then Flashing Operation is activated. In this case "G-G" on Abnormal Pilot Lamp is turned ON.
- ② Maximum time and minimum time of each step is observed, each step is maintained at least for a minimum time, but when the indication time takes the maximum time, Flashing Operation immediately starts. In this case "FAIL" on Abnormal Pilot Lamp is turned ON.

Step	Monitoring time	Maximum time (sec.)	Minimum time (sec.)
Short step (PW, PR, Y, R)		35	0.95
Middle step		110	0.95
Long step (G)		110	8

- ③ If the cause of the abnormal is eliminated, Flashing Operation will be canceled by pushing the "RESET" button.

(4) Operation switching

Changeover of operation mode can be safely performed without turning OFF the Main Switch; when two or more operation modes conflict with each other, operation priority is given to Flashing Operation, Manual Operation and Independent Multi-Plan Operation. And also switching of each operation except for Flashing Operation and patterns can be continuously activated without skipping any step.

(5) Indication time and changeover of pattern

Indication time and changeover of pattern are set at the Control Unit Panel.

① Indication time

It is possible to set the indication time from 1 to 99 by second. An error is under $\pm 3\%$ from a selected time.

It is also possible to set three patterns – P1, P2 and P3.

② Changeover of Pattern

"P1", "P2" and "P3" are switchable using the rotary switch (P.SEL) on the panel operator. Also, the switch is set at "AUT", the patterns are automatically switchable a maximum of 10 times a day.

(6) Phase data

Phase program, G-G program and Flashing Color Specification, all of them are set at diode matrix on the phase data substrate (PDU).

(7) Clock

Backup condenser makes it possible that clock circuitry in time switch works normally against the following kind of power cut.

- the power cut within 12 hours
- the power cut lasting within 30 minutes and repeating over 12 hours cycle

2.4.2 Power Supply Unit

The plug-in control power unit provides necessary electricity to each Operations.

- | | |
|---------------------------|---|
| (1) Input: | AC216 to 254V 50/60Hz \pm 5Hz per unit |
| (2) Output: | a rated voltage of DC 5V \pm 0.25V, a maximum rated current of 3A
a rated voltage of \pm DC 12V \pm 1V, a maximum rated current of 0.2A |
| (3) Dividing output: | a rated voltage of 8 to 15V, a rated current of 10mA |
| (4) Protection circuitry: | ① If the input voltage goes down under 80V, output voltage off will be turned off.
② It protects the interior against inputting an abnormal voltage of 150V half wave
③ It is operable within input 10ms of a moment power.
④ It protects excess voltage output. (up to 5V)
⑤ It protects the power against short circuit of the output terminal. |

2.4.3 Lamp Switch Unit

This unit consists of 4 Plug-in Lamp Switch Unit (SSU), perceives the lamp colour driving signals and lights the lamps using the lamp switch element.

- (1) This Unit can house a maximum of 6 Lamp Switch Elements (3 vehicles, 2 pedestrians 1 arrow) per 1 unit. It houses a maximum of 24 Lamp Switch Elements by 4 Units.
- (2) Each Lamp Switch Element can supply a maximum current of 5A with power. It prevents external surge from

breaking into the controller side because input side is insulated electrically from output side by installing SSR. And it decreases making noise as little as possible by switching lamp power near 0V.

- (3) This unit consists of phase 1 to 4 from the top. The monitor lamps in front of it helps confirming the phase even with the lamp OFF.

2.4.4 Manual Operation Unit

- (1) This Unit can be run by manual or automatic operation using the Operation Switch.
- (2) When the Operation Switch in the Manual Operation Unit is set at "Manual," a signal indication is advanced by one step every time the Pushbutton for Manual Operation is pressed. Unless it is pressed the indication in a current step can be continued.

2.4.5 Junction

- (1) This unit consists of the terminal board for line wire connection, Main Power Switch and Lamp Power Switch.
 - ① The Type of the Main Power Switch is 30 A frame type with a normal-temperature rating of 30A. It can supply the Lamp Power Switch with a maximum current of 25A.
 - ② The Lamp Power Switch is separately switchable regardless of other circuitry.

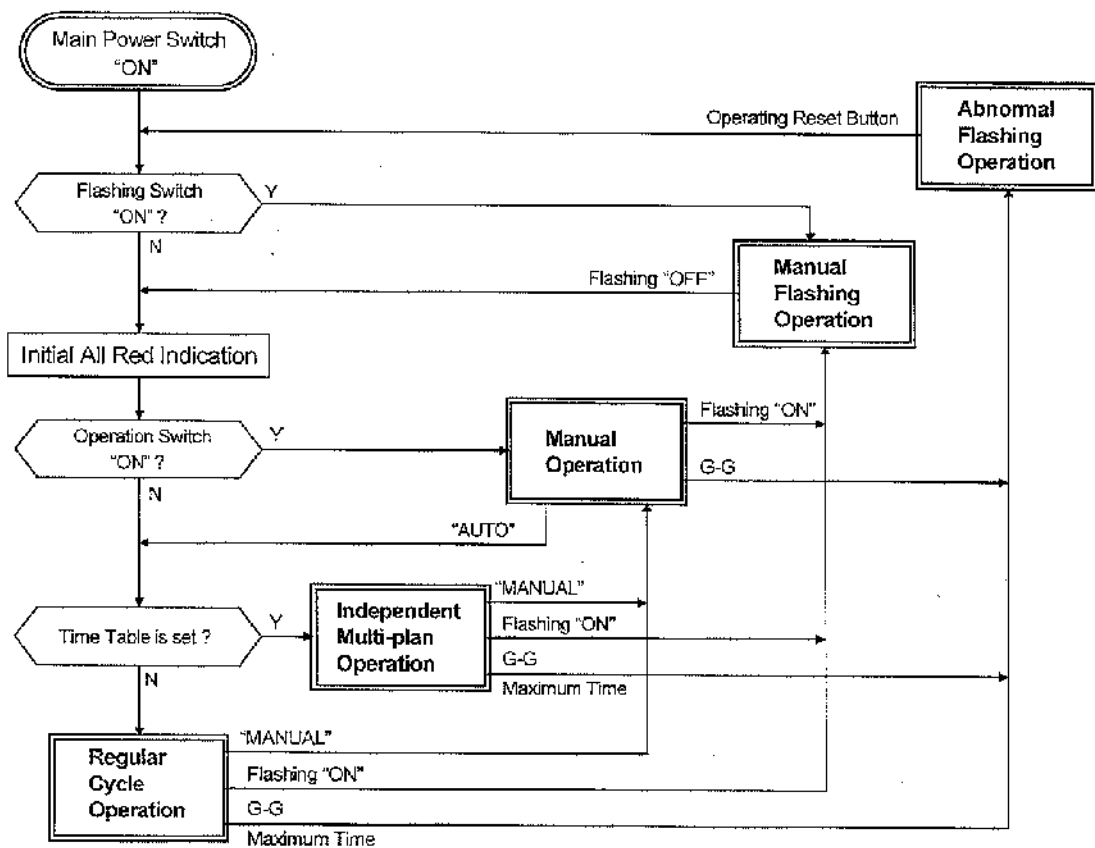


Fig.2.1 Operation flowchart



The instruction Manual of
A04-TYPE MULTI-PLAN SYSTEM
TRAFFIC SIGNAL CONTROLLER

Kyosan Electric Mfg. Co., Ltd.

SAFETY PRECAUTIONS

This "Instruction Manual" contains "installing, operating and maintaining" instructions and safeguards. Read the "Instruction Manual" before " " contains "installing, operating and maintaining" the "A04-TYPE MULTI-PLAN SYSTEM TRAFFIC SIGNAL CONTROLLER" to ensure the equipment offers you maximum service and is used properly and safely. Keep the " A04-TYPE MULTI-PLAN SYSTEM TRAFFIC SIGNAL CONTROLLER" in a convenient location for future reference.

Never attempt any procedure on the " A04-TYPE MULTI-PLAN SYSTEM TRAFFIC SIGNAL CONTROLLER" that is not specifically described in the "Instruction Manual". Unauthorized operation can cause faults or accidents. Kyosan is not liable for any problems resulting from unauthorized operation of equipment.

In the safety signs affixed on the " A04-TYPE MULTI-PLAN SYSTEM TRAFFIC SIGNAL CONTROLLER", to make certain situations clear the following signal words are used:



DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.



CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

CAUTION

CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.



NOTICE indicates information or a company policy that relates directly or indirectly to the safety of personnel or protection of property.

General safety signs indicates general instructions relative to safe work practices, reminders of proper safety procedures, or the location of safety equipment.

In the safety signs affixed on the " A04-TYPE MULTI-PLAN SYSTEM TRAFFIC SIGNAL CONTROLLER", to communicate different messages the following symbols are used:



A black image on a white square background means hazard alerting symbol. A symbol on the background indicates the type of hazard.

A blue circle means the mandatory action symbol. A symbol in the blue circle indicates the action mandated.



A red circular band with red diagonal slash on white background means prohibition symbol.

A symbol in the red circular band indicates the action prohibited.

A safety green image on a white background means information symbol.

A symbol on the background indicates the safety information.

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1. Outline

1.1 General

"A04-Type Traffic Signal Controller" is designed produced for mainly overseas use. That makes improving its maintainability and producing it at low possible.

This controller have the abilities to switch the indication time in response to traffic situation by setting control pattern and to control the signals in response to traffic characteristics.

The Controller consists of Control Unit, Power Unit, Lamp Switch Unit, Junction and Manual Operation Unit in terms of functions.

1.2 Configuration

Components of the Controller are shown in the following table.

Table 1.1 Component devices

Item	Device	Quantity
Main unit	Cabinet Manual Operation Unit Control Unit Power Supply Unit Lamp Switch Unit Junction	1 unit
	Pushbutton for Manual Operation	As required
Accessories	Key for main door of cabinet Key for door of Manual Operation Unit Connection code Mounting metal fixture	1 unit
Spare units	Fuse (3.15A for control power) Fuse (2A for IFU) Setting pins (for pin board)	2 pieces 2 pieces 3pins
Attached documents	Test Report Instruction Manual Operation Manual	3 copies As required 1 copy

2.Function and Ability

2.1 Main characteristics

(1) Improvement of Reliability

High efficiency integration of circuit and semiconductor device of power consumption controls interior evolution of heat and improves the reliability.

(2) Improvement of Maintainability

Making each Units components joint plug-in or plug-in style improves the maintainability.

(3) Maintenance of Safety

This controller maintains safety by the danger prevention (G-G protection) function for the phase.

(4) Time Setting

Pin board of panel operating unit makes the time setting easier.

2.2 Specifications

(1) Power Requirement	AC100V \pm 10% 50/60hz
(2) Power Consumption	approximately 70VA (excluding lamps)
(3) Ambient Temperature	-20 to +60°C
(4) Relative Humidity	40 to 90%
(5) Insulation Resistance	Between AC input terminals and Cabinet-10M Ω or more at DC500V (with arrester, etc., disconnected)
(6) Insulation Voltage	Between AC input terminals and Cabinet -AC 100V 1 minute (with arrester, etc., disconnected)
(7) Shape	400(W) \times 800(H) \times 300(L)mm
(8) Weight	approximately 70kg

2.3 Main Operation

2.3.1 Flashing Operation

Yellow signal in the major road side and red signal in the minor road side flash alternately. During Flashing Operation, Pedestrian Signal Lamps and Arrow Mark Lamps go out.

Flashing Operation works in the following cases:

- > When the time was set by Time Switch.(pattern flashing)
- > When the Flashing Switch on the Control Unit Panel is turned "ON". (manual flashing)
- > When the indication time becomes abnormally long.(abnormal flashing)
- > When green signal are indicated at the same time for crossing traffic flows.(abnormal flashing)

2.3.2 Manual operation

When the Operation Switch in the Manual Operation Unit is set at "Manual", a signal indication is advanced by one step every time the Pushbutton for Manual Operation is pressed. Unless it is pressed, the indication in a current step can be continued.

2.3.3 Multi-Plan Operation

This Operation executes three kind of patterns different in indication time of specified step (a maximum of 5 steps) in advance.

2.3.4 Regular Cycle Operation

This Operation repeats the specified pattern all day. Changeover of a pattern is controlled by the Pattern Switch on the Control Unit Panel. When Time Switch power is turned OFF or time table is not set, pattern 1 (P1) takes Regular Cycle Operation.

2.3.5 Interlocking Operation (Option)

This Operation can be activated by mounting an IFU Card.

- Function of Interlocking Master Unit
Output periodic signals (A/B) to Interlocking Slave Unit.
- Function of Interlocking Slave Unit

Receives periodic signals from Interlocking Master Unit and performs interlocking operations.

In an interlocking operation, the first step is to wait for a change from "A" to "B," the offset time in seconds, set at that time, is counted, and after counting, the phase advances to the next step (second step).

2.4 Function and Ability of Each Units

2.4.1 Control Unit

This Unit consists of MCU Card, PDU Card and Time Switch. It displays and designates each Operation, and controls the lamp color and each Operation works like Figure.2.1 Operation flow according to the position of switch and signal situation.

(1) Indication function

- ① Step (1-16) Pilot Lamps
- ② Clock Pilot Lamps (CLOCK)
- ③ Abnormal Pilot Lamps (G-G-FAIL)
- ④ Manual Flashing Operation Pilot Lamp (FL)
- ⑤ Running Pattern Pilot Lamps (P1,P2,P3,F)

(2) Initial all red indication

When the main power is turned ON, the power return after the power cut and operating Reset Button, starts normal Operation with first step after displaying red signal for 5 seconds to all phases. However when Flashing Switch is set to "ON", not performing all red display in first stage, immediately starts Flashing Operation.

(3) Operation in abnormal condition

- ① When green signal lamps are indicated at the same time for crossing traffic flows, the green signal lamps are once completely turned OFF in any operation mode, and then Flashing Operation is activated. In this case "G-G" on Abnormal Pilot Lamp is turned ON.
- ② Maximum time and minimum time of each step is observed, each step is maintained at least for a minimum time, but when the indication time takes the maximum time, Flashing Operation immediately starts. In this case "FAIL" on Abnormal Pilot Lamp is turned ON.

Step	Monitoring time	Maximum time (sec.)	Minimum time (sec.)
Short step (PW, PR, Y, R)		35	0.95
Middle step		110	0.95
Long step (G)		110	8

- ③ If the cause of the abnormal is eliminated, Flashing Operation will be canceled by pushing the "RESET" button.

(4) Operation switching

Changeover of operation mode can be safely performed without turning OFF the Main Switch; when two or more operation modes conflict with each other, operation priority is given to Flashing Operation, Manual Operation and Independent Multi-Plan Operation. And also switching of each operation except for Flashing Operation and patterns can be continuously activated without skipping any step.

(5) Indication time and changeover of pattern

Indication time and changeover of pattern are set at the Control Unit Panel.

① Indication time

It is possible to set the indication time from 1 to 99 by second. An error is under $\pm 3\%$ from a selected time. It is also possible to set three patterns -P1,P2 and P3.

② Changeover of Pattern

"P1", "P2" and "P3" are switchable using the rotary switch (P.SEL) on the panel operator. Also, the switch is set at "AUT", the patterns are automatically switchable a maximum of 10 time a day.

(6) Phase data

Phase program, G-G program and Flashing Color Specification, all of them are set at diode matrix on the phase data substrate (PDU).

(7) Clock

Backup capacitor makes it possible that clock circuitry in time switch works normally against the following kind of power cut.

- the power cut within 12 hours
- the power cut lasting within 30 minutes and repeating over 12 hours cycle

2.4.2 Power Supply Unit

The plug-in control power unit provides necessary electricity to each Operations.

- (1) Input: AC100V $\pm 10\%$ 50/60hz ± 5 hz per unit
- (2) Output: a rated voltage of DC5V ± 0.25 V, a maximum rated current of 3A
a rated voltage of \pm DC12V ± 1 V, a maximum rated current of 0.2A
- (3) Dividing output: a rated voltage of 8 to 15V, a rated current of 10mA
- (4) Protection circuitry:
 - ① If the input voltage goes down under 80V, output voltage off will be turned off.
 - ② It protects the interior against inputting an abnormal voltage of 150V half wave.
 - ③ It is operable within input 10ms of a moment power.
 - ④ It protects excess voltage output. (up to 5V)
 - ⑤ It protects the power against short circuit of the output terminal.

2.4.3 Lamp Switch Unit

This unit consists of 4 Plug-in Lamp Switch Unit (SSU), perceives the lamp color driving signals and light the lamps using the lamp switch element.

- (1) This Unit can house a maximum of 6 Lamp Switch Elements (3 vehicles, 2 pedestrians, 1 arrow) per 1 unit. It houses a maximum of 24 Lamp Switch Elements by 4 Units.
- (2) Each Lamp Switch Element can supply a maximum current of 5A with power. It prevents external surge from breaking into the controller side because input side is insulated electrically from output side by installing SSR. And it decreases making noise as little as possible by switching lamp power near 0V.
- (3) This unit consists of phase 1 to 4 from the top. The monitor lamps in front of it helps confirming the phase even with the OFF.

2.4.4 Manual Operation Unit

- (1) This Unit can be run by manual or automatic operation using the Operation Switch.
- (2) When the Operation Switch in the Manual Operation Unit set at "Manual," a signal indication is advanced by one step every time the Pushbutton for Manual Operation is pressed. Unless it is pressed the indication in a current step can be continued.

2.4.5 Junction

- (1) This unit consists of the terminal board for line wire connection, Main Power Switch and Lamp Power Switch.
 - ① The Type of the Main Power Switch is 30A frame type with a normal-temperature rating of 30A. It can supply the Lamp Power Switch with a maximum current of 25A.
 - ② The Lamp Power Switch is separately switchable regardless of other circuitry.

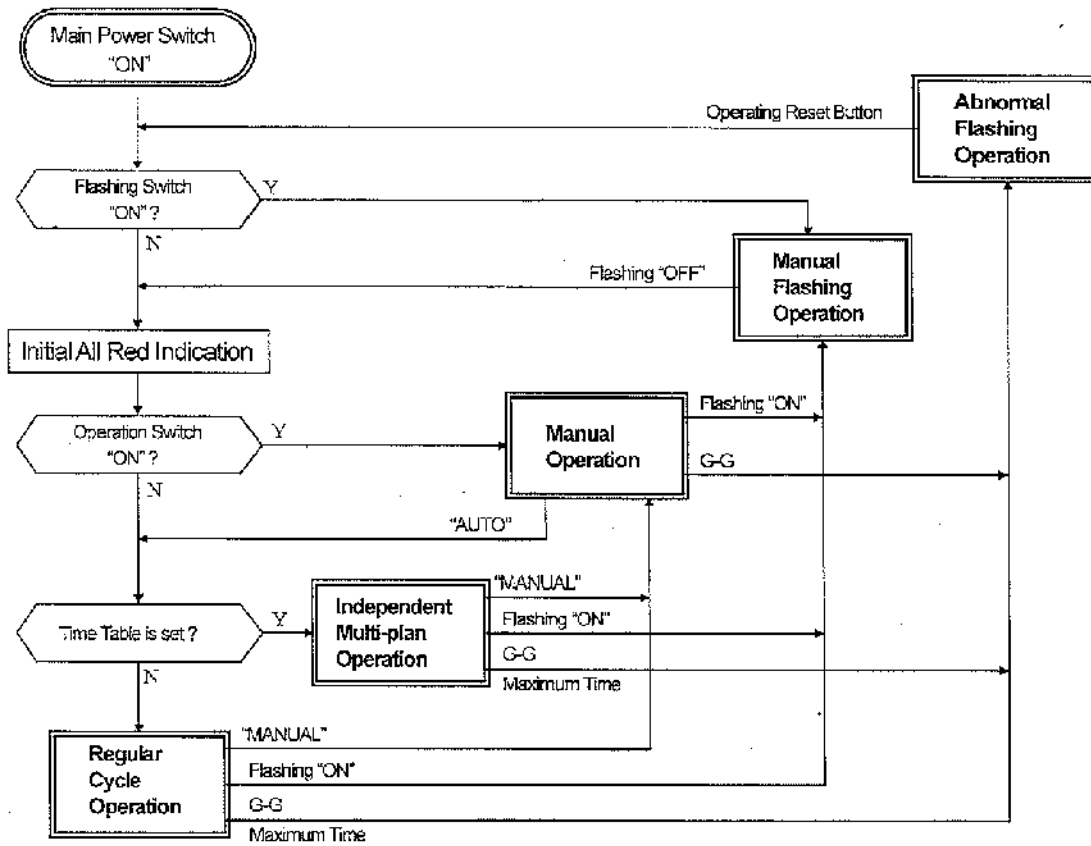


Figure.2.1 Operation Flowchart

Operation Manual
of
TRAFFIC SIGNAL CONTROLLER
TYPE: CF4200

Carefully read this operation manual beforehand for proper machinery operation.

TSEC

Transportation Systems & Electric Co., Ltd.

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1. Outline

1.1 General

The Traffic Signal Controller offered in this Manual is mainly designed for overseas use. The Traffic Signal Controller is designed so as to realize high reliability, stability, low power consumption, increase of maintainability and decrease of size by combining the exclusive LSI for traffic controlling equipment and high quality MPU.

Consequently, the Traffic Signal Controller can change time indication by preset controlling pattern in accordance with traffic conditions for weekdays, Saturday, holidays and special days. In other words, traffic signal control corresponding to the change of traffic characteristics is available by the Traffic Signal Controller. The Traffic Signal Controller consists of *Control Unit*, *Power Supply Unit*, *Signal Light Switch Unit*, *Junction Unit* and *Manual Control Unit*.

1.2 Configuration

Components of the Traffic Signal Controller are shown in the following table.

Table 1-1 Components

Item	Device	Quantity
Main Unit	Cabinet Manual Operation Unit Control Unit Power Supply Unit Signal Light Switch Unit Junction Unit	1 unit
Accessories	Push Button for Manual Operation Key for Traffic Signal Controller Connection Cable Mounting Metal Fixture	1 unit
Spares	Fuse (3.15A for control power supply) Fuse (5A for maintenance)	2 pcs. 2 pcs.
Attached Documents	Test Report Operation Manual	As required

2. Function and Ability

2.1 Main Characteristics

1. Improvement of Reliability

High efficient integration of circuit and low power consumption semiconductor devices control interior evolution of heat causing faults and improve reliability.

2. Improvement of Maintainability

Making each unit component as connector or plug-in style improves maintainability.

3. Improvement of Safety

The Traffic Signal Controller maintains safety of phase by the danger prevention (G-G protection) function.

4. Improvement of Time Accuracy

Quartz clock assures time accuracy.

5. Time Setting

Setting buttons of Control Panel enables easy time setting.

6. Watching Abnormality of Power Supply Unit

Backing up for instantaneous power failure for 10 ms or less is prepared. And abnormal signal output is not originated even for extraordinary voltage down.

2.2 Specifications

Table 2-1 Specifications

Input Power	90 to 110V AC, 50/60 Hz
Power Consumption	Approx. 50 VA (excl. signal light current)
Ambient Temperature	-20 to +60°C
Relative Humidity	40 to 90 %
Insulation Resistance	10 MΩ or more at 500 VDC between AC input terminal and the cabinet (Measured by disconnecting arrestor)
Insulation Voltage	1,000 VAC, 1 minute between AC input terminal and the cabinet (Measured by disconnecting arrestor).
Dimensions	400(W) x 800(H) x 300(D) mm
Weight	Approx. 70kg

2.3 Main Operation

2.3.1 Flashing Operation

“YELLOW” on the major road and “RED” on the minor road flash alternatively. During Flashing Operation, pedestrian signal lights and arrow signal lights turn off. Flashing Operation is carried out in the following situations:

- * Flashing Operation Function is set on the Time Table (Function Flashing)
- * Flashing Switch on the Control Unit is turned “ON” (Manual Flashing)
- * “GREEN” are indicated to the 2 or more crossing traffic flows at the same time (G-G Confliction)
- * Passing time of a step exceeds the prescribed value in Fail Safe Operation (Time Out)

2.3.2 Manual Operation

When the Operation Switch in the Manual Operation Unit is set to “Manual”, signal indication proceeds step by step by pushing Manual Button. Unless Manual button is pushed, the indication on the current step continues.

2.3.3 Fail Safe Operation

This operation is directly controlled by the exclusive LSI without relying on the MPU. And the operation is carried out in the following situations:

- * The clock works extraordinarily
- * Multi-plan Operation Time Table is not set
- * Pattern Changing Time Table is not set though the Multi-step Operation Time Table is set
- * Passing time of a step exceeds the prescribe value in Multi-plan Operation

2.3.4 Multi-plan Operation

On Multi-plan Operation, the MPU selects the appropriate “Pattern” from Multi-plan Operation Time Table according to the “Program” from Pattern Changing Time Table. 10 patterns can be set in Multi-plan Operation Time Table, and 10 pattern-changings can be set in Pattern Changing Time Table.

This operation is carried out when both Multi-plan Operation Time Table and Pattern Changing Time Table are set.

2.4 Function and Ability of Each Unit

2.4.1 Control Unit

The Control Unit controls indication of each function, processing of input and output signals and signal lights. The main print circuit board (LPC Card) is installed on the back of the Control Unit Panel.

1. Indicating Function

The situations of operation are indicated by indicators and display as follows.

- a) Executing item monitor lamp
- b) Data indicator
- c) In-operation indication lamp
- d) Error indication lamp (MPU, G-G Conflicition, Time Out)

2. Operations

Operations are carried out as the flow chart shown the Figure 2-1. The operation is relied on the position of switches and signal conditions.

- a) Action when the Main Power is switched on or Reset Button is pushed

After the Main Power is switched on, power is recovered after power failure, or Reset Button is pushed, the Traffic Signal Controller confirms the position of FLASHING SWITCH on the Control Unit Panel. If the switch is "FLASH ON" side, Flashing Operation starts immediately. If not, each "RED" of all the traffic signal turns on for about 5 seconds ("Initial All Red Indication").

Then, the Controller confirms the position of OPERATION SWITCH on the Manual Control Unit. If the switch is "MANUAL" side, Manual Operation starts. If not, Multi-plan Operation or Fail Safe Operation starts. "Which operation starts" is depends on the setting of 2 kinds of time table (see "2.3.4 Multi-plan Operation").

- b) Action in unusual status

- i: If "GREEN" are indicated to the 2 or more crossing traffic flows at the same time, the Traffic Signal Controller forces to turn off all "GREEN" indication immediately, and starts Flashing Operation. In this case, the error monitor lamp, "G-G", lights on.
- ii: If passing time of a step exceeds the prescribed value in Fail Safe Operation, the Traffic Signal Controller forces to turn off all "GREEN" indication immediately, and starts Flashing Operation. In this case, the error monitor lamp, "TIME OUT", lights on.
- iii: After removal the causes of faults, Flashing Operation ends by pushing the Reset Button.

- c) Operation change

Operation change is carried out safely without switching off the power supply. The priority of operations is classified from Flashing Operation, Manual Operation, Multi-plan Operation and Fail Safe Operation. Each operation except Flashing Operation is carried out in order and continuously without skipping the current steps.

3. Setting of Step, Pattern and Pattern-changing

The each step duration and pattern can be set at the Control Unit Panel.

a) Step

Duration of step can be set from one second to 99 seconds. The accuracy is $\pm 3\%$ of the set value.

b) Pattern and Pattern-changing

10 patterns (P1 – P9, PA) can be set on the Multi-plan Operation Time Table. A pattern consists of durations of each step.

10 pattern-changings can be set on the Pattern Changing Time Table. A pattern-changing consists of applicable patterns and its starting time.

Totally seven Kinds of Day type are available (Weekdays, Saturday, holidays and four special days).

Each Kind of Day type can have 10 pattern-changings.

4. Pattern for Fail Safe Operation

The pattern for Fail Safe Operation is set as Pattern 0 (P0) and it is changeable. However, P0 is not selectable at Multi-plan Operation.

5. Watching of Step duration

Watching of the maximum duration and the minimum duration of each step is available. There are 3 types of step, Short, Middle and Long. The type of each step is set before shipment, and is depends on what kind of signal indicates on the step. For example, YELLOW step is Short step, Vehicle GREEN step is Long step.

If passing time of a step exceeds the prescribed value in Multi-plan Operation, operation is changed to Fail Safe Operation. If in Fail Safe Operation, the exclusive LSI detects Time Out error and starts Flashing Operation.

Table 2-2 Type of Steps and Watching Duration

Step	Monitoring time	Maximum time (sec.)	Minimum time (sec.)
Short step		10	0.95
Middle step		110	0.95
Long step		110	6

6. Signal Light Phase Plan

The Signal Light Phase Plan is set as "Signal Phase Data". It is set before shipment and not-changeable. The maximum number of step is 30 and the maximum connectable Signal Light Switch Circuits are 24.

7. Clock and Calendar

The clock for controlling date and time operates correctly by back-up condenser even for the following power failures.

- * Power failure continuing within 12 hours
- * Power failure within 30 minutes occurring repeatedly over 12 hour cycle

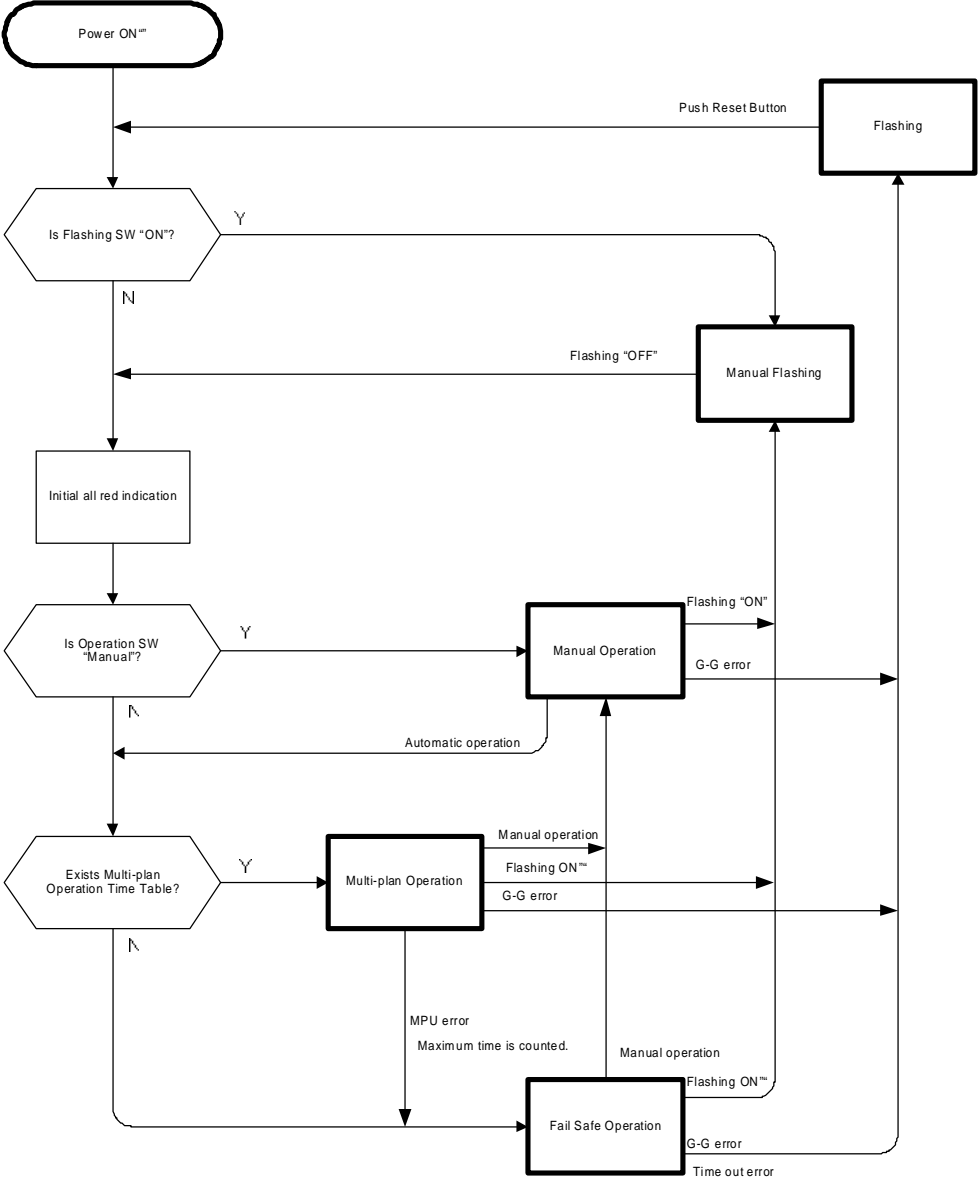


Figure 2-1 Flow Chart of Operations

2.4.2 Power Supply Unit

The Control Power Supply Unit is plug-in type and supplies necessary power stably.

1. Input 90 to 110 VAC, 50/60 Hz \pm 5Hz, single phase
2. Output Rating voltage 5 \pm 0.25 VDC, maximum rated current 3 A
 Rating voltage 12 \pm 1 VDC, maximum rated current 0.2 A
3. Protection circuit:
 - a) If the input voltage goes down to 80 VAC or less, the output is turned off.
 - b) It protects the interior circuit against an abnormal input voltage over 150 V, half wave.
 - c) It protects the operation for instantaneous power failure of 10 ms or less.
 - d) It protects over voltage output for 5V DC circuit.
 - e) It protects the Power Supply Unit against short circuit at the output terminal.

2.4.3 Signal Light Switch Unit

This unit consists of Signal Light Switch Units (SSU) and receives traffic signal light driving signal and lights the signal lights by the light switch elements.

1. This unit equips with 6 Light Switch Elements (for 3 vehicles, 2 pedestrians and 1 arrow) per unit.
2. It is plug-in type and maximally 4 units can be equipped. In other words, 24 Light Switch Units can be equipped maximally. The most upper shelf equips with the unit for phase 1 and the lowest shelf equips with the unit for phase 4.
3. Since monitor lamps for signal lights are prepared on the front panel, each phase can be confirmed even when signal lights are extinguished.
4. The maximum current for a signal switch element is 5A.
5. The input side and output side of the signal switch element are electrically isolated because solid state relays (SSR) are adopted and they prevent external surge. Also they decrease noise as low as possible when switching on and off the large current by switching the power for signal lights at near 0 volt.

2.4.4 Manual Control Unit

1. The following operations are carried out by the Operation Mode Selection SW.
 - a) Manual Operation
 - b) Automatic Operation
2. Manual Button only works when the Operation Mode Selection SW is turned to "MANUAL" side.
Signal indication precedes step by step every pushing Manual Button. Unless it is pushed, the indication in the current step continues.

2.4.5 Junction Unit

1. Terminals and Power Supply Switches are installed in the Junction Unit.
 - a) Main Power Supply Switch is 30 A frame with rated current of 30 A at normal temperature and maximally 25 A can be flowed to the Signal Light Switch. (Maximally 20 signal lights are connectable.)
 - b) The Signal Light Power Supply Switch can switch on and off the Signal Light Power Supply independently from other circuits.

“RENDO”(Interlocked) Operation

Traffic signal controller interlock master traffic signal controller by electrical signal. So that platoons of vehicles can proceed through a continuous series of green light.

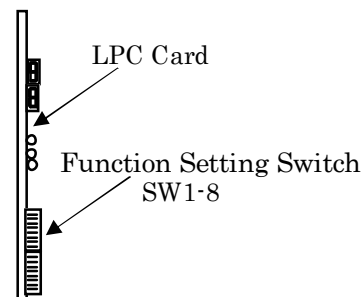
Setting procedure of “RENDO”(Interlocked) Operation

Set “RENDO”(Interlocked) Operation according to the following steps.

<1st step>

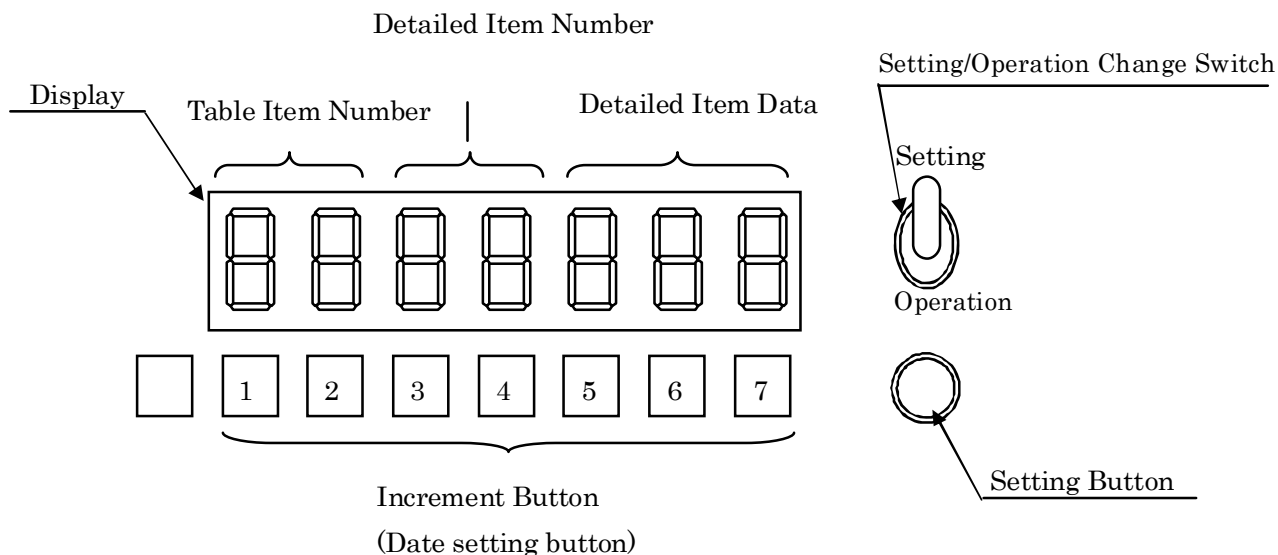
Start-up method of “Table Setting Mode”

- (1) Make function setting switch (SW1-8) on the LPC Card “ON”
- (2) In order to set Table Setting Mode, select “Setting” side of Setting/Operation Change Switch.



<2nd step>

Table Setting Method



1st Table Setting for TIME SETTING

- (1) Set Table Item Number to “65” (Time setting of “RENDO”(Interlocked) Operation) by pushing Increment Button NO.1&NO.2.
- (2) Set Detailed Item Number to the corresponding figures indicated in table (a)to(g) by pushing Increment Button NO.3 & NO.4.

- (3) Set Detailed Item Data to the corresponding figures indicated in table (a)to(g) by pushing Increment Button NO.5 & NO.6 & NO.7.
- (4) Push “Setting Button” in order to finalize the above figures.
- (5) Repeat the same procedures ((1)to(4)) for all kind of day and all start and end time.
(refer to setting example)

Tables of setting item for Time Setting of “RENDO”(Interlocked) Operation

(a) Week Day

Item			Detailed item number	Detailed item data
1	Start time	Hour	01	00 to 23
		Minute	02	00 to 59
	End time	Hour	03	00 to 23
		Minute	04	00 to 59
2	Start time	Hour	05	00 to 23
		Minute	06	00 to 59
	End time	Hour	07	00 to 23
		Minute	08	00 to 59
3	Start time	Hour	09	00 to 23
		Minute	10	00 to 59
	End time	Hour	11	00 to 23
		Minute	12	00 to 59
4	Start time	Hour	13	00 to 23
		Minute	14	00 to 59
	End time	Hour	15	00 to 23
		Minute	16	00 to 59

(c) Holiday

Item			Detailed item number	Detailed item data
1	Start time	Hour	33	00 to 23
		Minute	34	00 to 59
	End time	Hour	35	00 to 23
		Minute	36	00 to 59
2	Start time	Hour	37	00 to 23
		Minute	38	00 to 59
	End time	Hour	39	00 to 23
		Minute	40	00 to 59
3	Start time	Hour	41	00 to 23
		Minute	42	00 to 59
	End time	Hour	43	00 to 23
		Minute	44	00 to 59
4	Start time	Hour	45	00 to 23
		Minute	46	00 to 59
	End time	Hour	47	00 to 23
		Minute	48	00 to 59

(b) Saturday

Item			Detailed item number	Detailed item data
1	Start time	Hour	17	00 to 23
		Minute	18	00 to 59
	End time	Hour	19	00 to 23
		Minute	20	00 to 59
2	Start time	Hour	21	00 to 23
		Minute	22	00 to 59
	End time	Hour	23	00 to 23
		Minute	24	00 to 59
3	Start time	Hour	25	00 to 23
		Minute	26	00 to 59
	End time	Hour	27	00 to 23
		Minute	28	00 to 59
4	Start time	Hour	29	00 to 23
		Minute	30	00 to 59
	End time	Hour	31	00 to 23
		Minute	32	00 to 59

(d) Special Day1

Item			Detailed item number	Detailed item data
1	Start time	Hour	49	00 to 23
		Minute	50	00 to 59
	End time	Hour	51	00 to 23
		Minute	52	00 to 59
2	Start time	Hour	53	00 to 23
		Minute	54	00 to 59
	End time	Hour	55	00 to 23
		Minute	56	00 to 59
3	Start time	Hour	57	00 to 23
		Minute	58	00 to 59
	End time	Hour	59	00 to 23
		Minute	60	00 to 59
4	Start time	Hour	61	00 to 23
		Minute	62	00 to 59
	End time	Hour	63	00 to 23
		Minute	64	00 to 59

(e) Special Day2

Item			Detailed item number	Detailed item data
1	Start time	Hour	65	00 to 23
		Minute	66	00 to 59
End time	Hour	67	00 to 23	
	Minute	68	00 to 59	
2	Start time	Hour	69	00 to 23
		Minute	70	00 to 59
End time	Hour	71	00 to 23	
	Minute	72	00 to 59	
3	Start time	Hour	73	00 to 23
		Minute	74	00 to 59
End time	Hour	75	00 to 23	
	Minute	76	00 to 59	
4	Start time	Hour	77	00 to 23
		Minute	78	00 to 59
End time	Hour	79	00 to 23	
	Minute	80	00 to 59	

(g) Special day4

Item			Detailed item number	Detailed item data
1	Start time	Hour	97	00 to 23
		Minute	98	00 to 59
End time	Hour	99	00 to 23	
	Minute	A0	00 to 59	
2	Start time	Hour	A1	00 to 23
		Minute	A2	00 to 59
End time	Hour	A3	00 to 23	
	Minute	A4	00 to 59	
3	Start time	Hour	A5	00 to 23
		Minute	A6	00 to 59
End time	Hour	A7	00 to 23	
	Minute	A8	00 to 59	
4	Start time	Hour	A9	00 to 23
		Minute	B0	00 to 59
End time	Hour	B1	00 to 23	
	Minute	B2	00 to 59	

(f) Special Day3

Item			Detailed item number	Detailed item data
1	Start time	Hour	81	00 to 23
		Minute	82	00 to 59
End time	Hour	83	00 to 23	
	Minute	84	00 to 59	
2	Start time	Hour	85	00 to 23
		Minute	86	00 to 59
End time	Hour	87	00 to 23	
	Minute	88	00 to 59	
3	Start time	Hour	89	00 to 23
		Minute	90	00 to 59
End time	Hour	91	00 to 23	
	Minute	92	00 to 59	
4	Start time	Hour	93	00 to 23
		Minute	94	00 to 59
End time	Hour	95	00 to 23	
	Minute	96	00 to 59	

<3rd step>

2nd Table Setting for “KO”(SERVANT) SETTING

- (1) Set Table Item Number to “87” (“KO”(Servant) setting of “RENDO”(Interlocked) Operation) by pushing Increment Button NO.1&NO.2.
- (2) Set Detailed Item Number to the corresponding figures indicated by pushing Increment Button NO.3 & NO.4.
- (3) Set Detailed Item Data to the corresponding figures indicated by pushing Increment Button NO.5 & NO.6 & NO.7.
- (4) Push “Setting Button” in order to finalize.

Tables of setting item for “KO”(Servant) Setting of “RENDO”(Interlocked) Operation

Item	Detailed item number	Detailed item data
Cycle “RENDO”(Interlocked) Signal	01	1:AB type Interconnect Signal (normal condition) 2:Y type Interconnect Signal
“RENDO”(Interlocked) sub-cycle operation	02	1: 1/1 period (normal condition) 2: 1/2 period 3: 2/3 period
Threshold value of “RENDO”(Interlocked) sub-cycle operation	03	0 to 254, or blank(normal condition) In case of “blank” , the “RENDO” (Interlocked) operation is done. (not sub-cycle) When the threshold value of “RENDO” (Interlocked) sub-cycle operation is more than the cycle of master controller, this becomes “RENDO” (Interlocked) cycle operation.(not sub-cycle)
Synchronized Step (S1)	04	1 to 30, or blank. In case of “blank” , Synchronized Step isn’t designate.
Synchronized Step (S2)	05	1 to 30, or blank. In case of “blank” , Synchronized Step isn’t designate.
Watch time of cycle signal	06	0 to 255. (255:normal condition) When “RENDO” (Interlocked) cycle signal isn’t received within watch time of cycle signal, the “RENDO” (Interlocked) operation ends.
Pattern1	(S1)Offset 07	0 to 254, or blank. Offset time is set. In case of “blank” , the “RENDO” (Interlocked) operation isn’t done.
	(S2)Offset 08	
Pattern2	(S1)Offset 09	
	(S2)Offset 10	
Pattern3	(S1)Offset 11	
	(S2)Offset 12	
Pattern4	(S1)Offset 13	
	(S2)Offset 14	
Pattern5	(S1)Offset 15	
	(S2)Offset 16	
Pattern6	(S1)Offset 17	
	(S2)Offset 18	
Pattern7	(S1)Offset 19	
	(S2)Offset 20	
Pattern8	(S1)Offset 21	
	(S2)Offset 22	
Pattern9	(S1)Offset 23	
	(S2)Offset 24	
PatternA	(S1)Offset 25	
	(S2)Offset 26	

<4th step>

Operation Mode

- (1) After the 3rd step, switch the Setting/Operation Change Switch to “Operation” side. Consequently, Display indication also changes to figures of operation mode at the time.
- (2) Finally, set the function setting switch(sw1-8) “OFF”.

<<Setting example>>

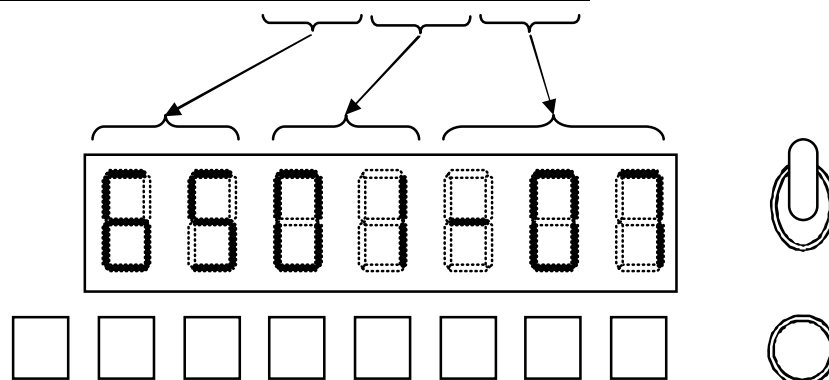
Condition:

- (1) Running time in “RENDO” (Interlocked) Operation is from 07:00 to 20:00 except special day.
- (2) Cycle “RENDO” (Interlocked) Signal : “1”(AB type)
- (3) “RENDO” (Interlocked) sub-cycle operation : “1”(1/1 period)
- (4) Threshold value of “RENDO” (Interlocked) sub-cycle operation : “blank”(not sub-cycle)
- (5) Synchronized Step: “1step” (s1) and “9step”(s2)
- (6) Watch time of cycle signal : “255”(max)
- (7) Offset time : “0”second for all pattern

Set figures as follows according to two table setting mode.

1st table< TIME SETTING >

		Table item number	Detailed item number	Detailed item data
(1)	Set the hour of the weekday start time.	65	01	07
(2)	Set the minute of the weekday start time.	65	02	00
(3)	Set the hour of the weekday end time.	65	03	20
(4)	Set the minute of the weekday end time.	65	04	00
(5)	Set the hour of the Saturday start time.	65	17	07
(6)	Set the minute of the Saturday start time.	65	18	00
(7)	Set the hour of the Saturday end time.	65	19	20
(8)	Set the minute of the Saturday end time.	65	20	00
(9)	Set the hour of the Holiday start time.	65	33	07
(10)	Set the minute of the Holiday start time.	65	34	00
(11)	Set the hour of the Holiday end time.	65	35	20
(12)	Set the minute of the Holiday end time.	65	36	00

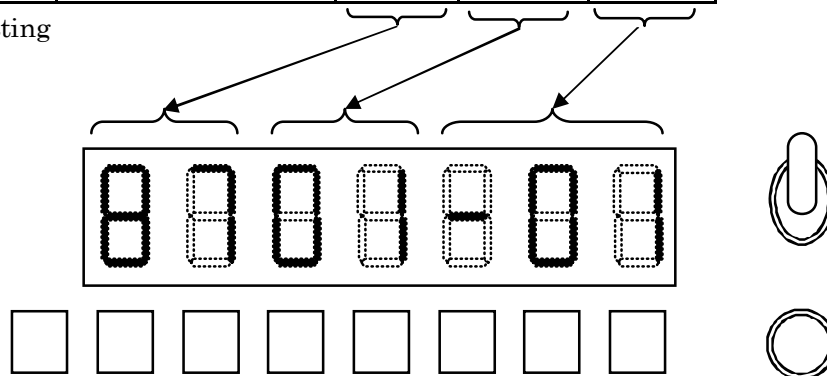


Setting example of Interlocked Operation at time setting

2nd Table <"KO"(SERVANT) SETTING>

Item		Table item number	Detailed item number	Detailed item data	
(1)	Cycle "RENDO" (Interlocked) Signal	87	01	1	
(2)	"RENDO" (Interlocked) sub-cycle operation	87	02	1	
(3)	Threshold value of "RENDO" (Interlocked) sub-cycle operation	87	03	---	
(4)	Synchronized Step (S1)	87	04	1	
(5)	Synchronized Step (S2)	87	05	9	
(6)	Watch time of cycle signal	87	06	255	
(7)	Pattern1	(S1)Offset	87	07	0
		(S2)Offset	87	08	0
(8)	Pattern2	(S1)Offset	87	09	0
		(S2)Offset	87	10	0
(9)	Pattern3	(S1)Offset	87	11	0
		(S2)Offset	87	12	0
(10)	Pattern4	(S1)Offset	87	13	0
		(S2)Offset	87	14	0
(11)	Pattern5	(S1)Offset	87	15	0
		(S2)Offset	87	16	0
(12)	Pattern6	(S1)Offset	87	17	0
		(S2)Offset	87	18	0
(13)	Pattern7	(S1)Offset	87	19	0
		(S2)Offset	87	20	0
(14)	Pattern8	(S1)Offset	87	21	0
		(S2)Offset	87	22	0
(15)	Pattern9	(S1)Offset	87	23	0
		(S2)Offset	87	24	0
(16)	PatternA	(S1)Offset	87	25	0
		(S2)Offset	87	26	0

-- " is no setting



Setting example of "RENDO" (Interlocked) Operation at "KO"(servant) setting