

Maximum Demand Controller Using Microcontroller IC AT89S52

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Abstract— Power is measured in momentary amounts, while vitality is the fundamental of control after some time. For instance, a 100 W light retains 100 W of force. In the event that worked for 60 minutes, that light ingests 100 W – hours of vitality. Greatest interest is the most extreme immediate force expended over a predetermined window of time. On account of that 100 W globule, as it is exchanged on and off, the quick request goes from zero to 100 W to zero, and so on. Not exceptionally intriguing. However, in the event that that knob is worked in parallel with a second 100 W light that is left on constantly, the interest will switch momentarily between 100 W and 200 W, and the most extreme interest of the blend will be 200 W. Presently, the way this is connected is that electric dissemination utilities regularly incorporate interest as one of the variables used to decide the bill the buyer gets. Notwithstanding measuring coordinated vitality utilization over the charging period (normally a month), they likewise measure request. Instead of measure genuinely immediate qualities, they really measure vitality over a short window of time, and afterward partition the vitality expended amid that interim by the length of the interim to land at a powerful crest worth for the interim. This is done in light of the fact that genuinely momentary estimations can be misshaped by basic occasions, for example, beginning an engine (ElSayed, 1999). In this way, for instance it is genuinely basic to see request alluded to as 'fifteen moment request' since it is the successful crest quality over a fifteen moment window of time. The explanation behind measuring and charging for interest is that the appropriation utility needs to work out its framework to have the capacity to bolster the crest utilization by its clients. Measuring and charging for greatest interest is a method for evaluating the extent to which the necessities of individual clients are driving the extension of the framework that backings all clients (Mostafa et al., 2004).

Keywords—MDI, Power variable, Penalty, Load administration

Introduction

The best normal estimation of the force, obvious force, or current devoured by a client of an electric force framework, the midpoints being assumed control progressive time periods, generally 15 or 30 minutes long.

It is the best request of burden on the force station amid a given period, i.e., the greatest of the considerable number of requests that have happened amid a given period (might be a day, might be 60 minutes, and so on.).

Need of most extreme interest in Electricity bill?

At the point when the rate of electrical vitality is charged on the premise of most extreme interest of the purchaser and the units devoured, it is called two-section tax. In this aggregate charge is partitioned into two.

1. Altered charge relies on upon greatest interest of customer.
2. Running charge relies on upon no. of units devoured. It is installing so as to measure most extreme interest meter. Charges are made on the premise of greatest interest in KVA and not in kW.

The most extreme interest is further part into four sorts, specifically:

1. Day by day greatest (0530 h to 1630 h and 1830 h to 2100 h).
2. Confined greatest (1630 h to 1830 h).
3. Night most extreme (2100 h to 0500 h).
4. Weekend most extreme (Saturday 0500 h to Monday 0500 h).

Every kind of greatest interest has an alternate duty. Most extreme interest is typically measured as a normal over a half hour period. The most extreme half hour normal achieved request drawn, as is frequently misconstrued, however the time incorporated interest over the predefined recording cycle. As sample, in an industry,

in the event that the drawl over a recording cycle of 30 minutes is: 2500 KVA for 4 minutes

3600 KVA for 12 minutes

4100 KVA for 6 minutes

3800 KVA for 8 minutes

The MD recorder will be registering MD as:

$$\frac{2500 \times 4 + 3600 \times 12 + 4100 \times 6 + (3800 \times 8)}{30}$$

30

=3606.7 KVA as can be seen from the Figure 1 underneath, the interest shifts occasionally. The interest is measured over foreordained time interim and found the middle value of out for that interim as appeared by the even specked line. amid the month gives the month to month most extreme interest charge (Gaggioli, 1983; and Clive Beggs, 2002).

It is critical to note that while most extreme interest is recorded, it is not the momentary.

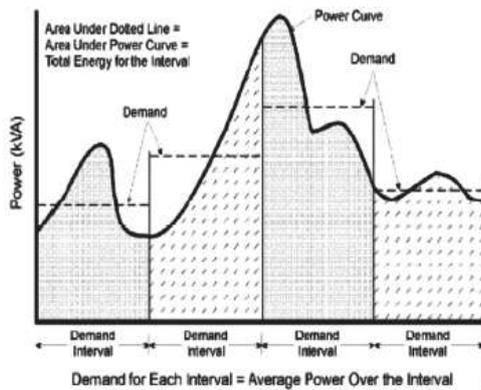


Fig.1 Power And Demand Control

MDI PENALTY

The MDI punishment can be kept away from by using so as to enhance the force variable and more productive apparatuses.

Another alternative of maintaining a strategic distance from MDI punishment is by moving your crest burden to a period of day when your heap is less.

There are 2 strategies for ascertaining MD (Maximum Demand):

'Ordinary OR BLOCK METHOD

Toward the end of every fix coordinating period, normal force for that period is computed. On the off chance that this quality is more noteworthy than effectively existing esteem then this is put away as the MD.

SLIDING WINDOW METHOD

Toward the end of a sub coordinating period the avg force is ascertained for one incorporating period. On the off chance that this quality is more prominent than the officially existing worth than this is put away as MD. The incorporating period slides by a window of the sub coordinating period (Capasso et al., 1994; and World Bank, 2012).

MDNo.	Method	Intg. Period	Sub Intg. Period
MD 1	Sliding	30 min	15 min
MD 2	Block	30 min	30 min

Expect a heap example of taking after sort:

T = 09.00, T = 09.15, T = 09.30, T = 09.45, T = 10.00
 KVA, 30 KVA, 30 KVA, 20 KVA 15 mins, 15 mins, 15 mins,

15 mins For MD 1 (Sliding window technique) Demand – 09.00 to 09.30 piece

$$= \frac{(20 * 15 + 30 * 15)}{30}$$

$$= 25 \text{ KVA}$$

Request – 09.15 to 09.45 piece

$$= \frac{(30 * 15 + 30 * 15)}{30}$$

$$= 30 \text{ KVA}$$

Request – 09.30 to 10.00 piece

$$= \frac{(30 * 15 + 20 * 15)}{30}$$

$$= 25 \text{ KVA}$$

MD 1 toward the end of 10.00 = 30 KVA For MD 2 (Block strategy) Demand – 09.00 to 09.30 square

$$= \frac{(20 * 15 + 30 * 15)}{30}$$

$$= 25 \text{ KVA}$$

Request -09.30 to 10.00 block

$$= \frac{(30 * 15 + 20 * 15)}{30}$$

$$= 25 \text{ KVA}$$

MD 2 toward the end of 10.00 = 25 KVA

.Typically MD is reset on the first of consistently,i.e., on a Monthly premise.

MICROCONTROLLER BASED MDI

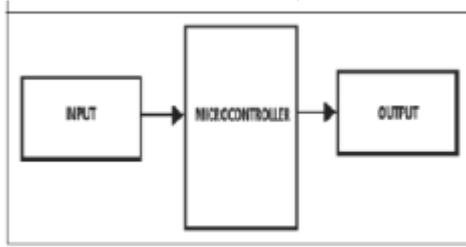
The customary greatest interest metering utilized traditional meters with current transformers.. The meter took a shot at a 15 minute normal with a pointer which demonstrated the greatest came to since the last time the pointer was reset. It has a few downsides, as:

- The meter did not compare precisely to the supply power's meter qualities as a result of contrasts in the averaging times and contrasts in reset times.
- This meter couldn't be checked consistently and high most extreme interest qualities were frequently recorded when issues happened on the factory and the administrator had neglected to see the intemperate greatest interest.
- It was exceptionally hard to find precisely when the greatest interest had been surpassed because of an absence of any recording.
- It was hard to foresee the impacts of including or uprooting load.

Along these lines, a microcontroller based MDI and Controller is presented.

It computes the KVA and kW values around consistently and showcases these on the VDU for the force station specialist or movement circuit tester to see. Each half hour, toward the end of each metering period (after a reset has happened), the KVA, kW and force variable recorded amid that time, is printed by the printer together with a

straightforward chart contrasting the genuine KVA and the set point (Cobus, 2003; and IOSR, 2012).



II. PHILOSOPHY

Most extreme Demand Controller is a gadget intended to address the issue of commercial enterprises aware of the estimation of burden administration.

Alert is sounded when interest methodologies a preset quality. In the event that restorative measures are not taken, the controller switches off unnecessary burdens in a consistent grouping.

Request control plan is actualized by utilizing suitable control contactors. Sound and visual annunciations could likewise be utilized.

The heap shedding of the feeders can be founded on a few rationales which prompt the improvement of various techniques for the interest controllers. For outlining the MDI there are three primary procedures for computation of MDI As:

Altered Priority Strategy

A Fixed priority strategy not only sheds the least important loads first and the most important load last. The fixed priority strategy has the advantage of keeping high priority areas supply "ON" while low priority areas will be "OFF" during peak demand periods.

Pivoting Strategy

In a pivoting methodology, an equivalent dispersion of force is given to every controlled burden. This technique is suitable when all zones rooms require an equivalent offer of force.

Mix Fixed/Rotate Strategy

It is the most flexible and intense procedure in light of the fact that there are such a large number of conceivable mixes. A mix load procedure permits gatherings of turning burdens to be customized with or without settled need loads. This can bring about the greatest effectiveness and vitality cost investment funds.

Notwithstanding the estimation of the MDI this undertaking has an ability of recurrence identification and sign as there is a cozy relationship between the recurrence and the force (request/supply) which is appeared in Figure 3 underneath:

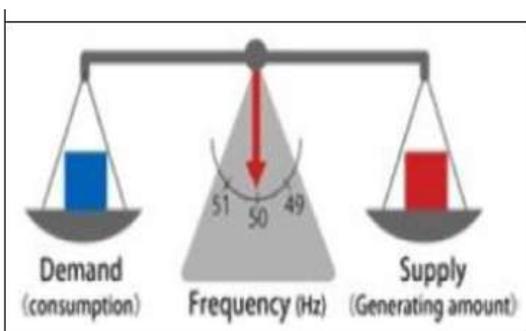


Fig.3 RELATIONSHIP BETWEEN THE FREQUENCY AND POWER (DEMAND/SUPPLY)

ELECTRICAL LOAD MANAGEMENT

Requirement for Electrical Load Management In a full scale point of view, the development in the power use and differences of end use portions in time of utilization has prompted deficits in ability to take care of demand. As limit expansion is expensive and just quite a while prospect, better load administration at client end minimizes top requests on the utility foundation and better use of force plant limits.

The utilities (State Electricity Boards) use power duty structure to impact end client in better load administration through measures like time of utilization levies, punishments on surpassing permitted most extreme interest, night levy concessions, and so on.

MAXIMUM DEMAND CONTROL

Step By Step Approach for Maximum Demand Control:

Load Curve Generation

Presenting the load demand of a consumer against time of the day is known as a 'load curve'. If it is plotted for the 24 hours of a single day, it is known as an 'hourly load curve' and if daily demands plotted over a month, it is called daily load curves. These types of curves are useful in predicting patterns of drawl, peaks and valleys and energy use trend in a section or in an industry or in a distribution network as the case may be.

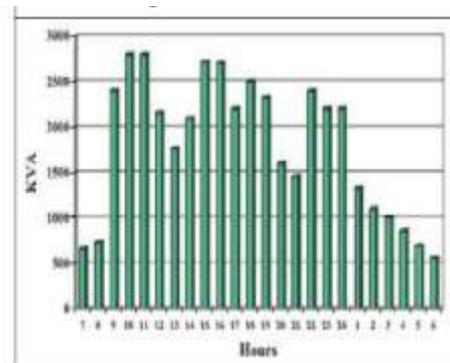


Fig.4 LOAD CURVE

Rescheduling of Loads

Rescheduling of large electric loads and equipment operations, in different shifts can be planned and implemented to minimize the simultaneous maximum demand. For this purpose, an operation flow chart and a process chart are prepared. Analyzing these charts and with an integrated approach, will help to improve the load factor which in turn reduces the maximum demand.

Storage of Products/in Process Material/Process Utilities Like Refrigeration

It is possible to reduce the maximum demand by building up storage capacity of products/ materials, water, chilled water/hot water, using electricity during off peak periods. Shedding of Non-Essential Loads When the maximum demand tends to reach preset limit,

shedding some of non-essential loads

temporarily can help to reduce it. Sophisticated microprocessor controlled systems are also available, which provide a wide variety of control options like:

- Accurate prediction of demand
- Graphical display of present load, available load, demand limit.

- Visual and audible alarm.
- Automatic load shedding in a predetermined sequence.
- Automatic restoration of load.
- Recording and metering.

Operation of Captive Generation and Diesel Generation Sets

When diesel generation sets are used to supplement the power supplied by the electric utilities, it is advisable to connect the DG sets for durations when demand reaches the peak value. This would reduce the load demand to a considerable extent and minimize the demand charges.

Reactive Power Compensation

The maximum demand can also be reduced at the plant level by using capacitor banks and maintaining the optimum power factor. Capacitor banks are available with microprocessor based control systems. These systems switch on and off the capacitor banks to maintain the desired Power factor of system and optimize maximum demand thereby (Calcutt et al., 1998; and Cobus, 2003).

POWER FACTOR IMPROVEMENT AND BENEFITS

Power Factor Basics

In all industrial electrical distribution systems, the major Loads are resistive and inductive. Resistive loads are incandescent lighting and resistance heating. In case of pure resistive loads, the voltage (V), current (I), resistance (R) relations are linearly related,

i.e.,

$$\text{Voltage (V)} = IR$$

$$\text{and Power (kW)} = VI$$

Typical inductive loads are AC Motors, induction furnaces, transformers and ballast type lighting.

Inductive loads require two kinds of power:

1. Active (or working) power to perform the work, and
2. Reactive power to create and maintain electromagnetic fields

. Active power is measured in kW (Kilo Watts). Reactive power is measured in kVAr (Kilo Volt-Amperes Reactive). The vector sum of the active power and reactive power make up the total (or apparent) power used. This is the power generated by the SEBs for the user to perform a given amount of work. Total Power is measured in KVA (Kilo Volts-Amperes).

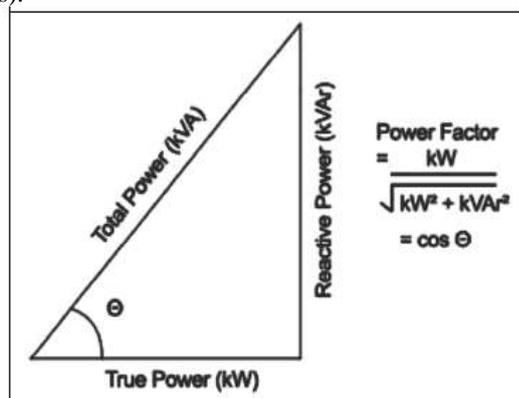


Fig.5 POWER TRIANGLE

The active power (shaft power required or true power required) in kW and the reactive power required (KVAR) are

90° apart vectorically in a pure inductive circuit, i.e., reactive power KVAR lagging the active kW. The vector sum of the two is called the apparent power or KVA, as illustrated above and the KVA reflects the actual electrical load on distribution system (Brown, 2008)

The ratio of kW to KVA is called the power factor, which is always less than or equal to unity. Theoretically, when electric utilities supply power, if all loads have unity power factor, maximum power can be transferred for the same distribution system capacity. However, as the loads are inductive in nature, with the power factor ranging from 0.2 to 0.9, the electrical distribution network is stressed for capacity at low power factors.

IMPROVING POWER FACTOR

The solution to improve the power factor is to add power factor correction capacitors to the plant power distribution system.

They act as reactive power generators, and provide the needed reactive power to accomplish kW of work. This reduces the amount of reactive power, and thus total power, generated by the utilities.

ADVANTAGES OF PF IMPROVEMENT BY CAPACITOR ADDITION

- Reactive component of the network is reduced and so also the total current in the system from the source end.
- I² R power losses are reduced in the system because of reduction in current
- Voltage level at the load end is increased.
- KVA loading on the source generators as also on the transformers and lines up to the capacitors reduces giving capacity relief. A high power factor can help in utilising the full capacity of your electrical system (Calcutt et al., 1998; and Mc Donald, 2003)

COST BENEFITS OF PF IMPROVEMENT

While costs of PF improvement are in terms of investment needs for capacitor addition the benefits to be quantified for feasibility analysis are:

- Reduced KVA (Maximum demand) charges in utility bill.
- Reduced distribution losses (KWH) within the plant network
- Better voltage at motor terminals and improved performance of motors
- A high power factor eliminates penalty charges imposed when operating with a low power factor.
- Investment on system facilities such as transformers, cables, switchgears, etc., for delivering load is reduced.

MAXIMUM DEMAND CONTROLLER

High-Tension (HT) consumers have to pay a maximum demand charge in addition to the usual charge for the number of units consumed. This charge is usually based on the highest amount of power used during some period (say 30 minutes) during the metering month. The maximum demand charge often represents a large proportion of the total bill and may be based on only one isolated 30 minute episode of high power use.

Considerable savings can be realised by monitoring power use and turning off or reducing non-essential loads during such periods of high power use.

Maximum Demand Controller is a device designed to meet the need of industries conscious of the value of load management. Alarm is sounded when demand approaches a preset value. If corrective action is not taken, the controller switches off non-essential loads

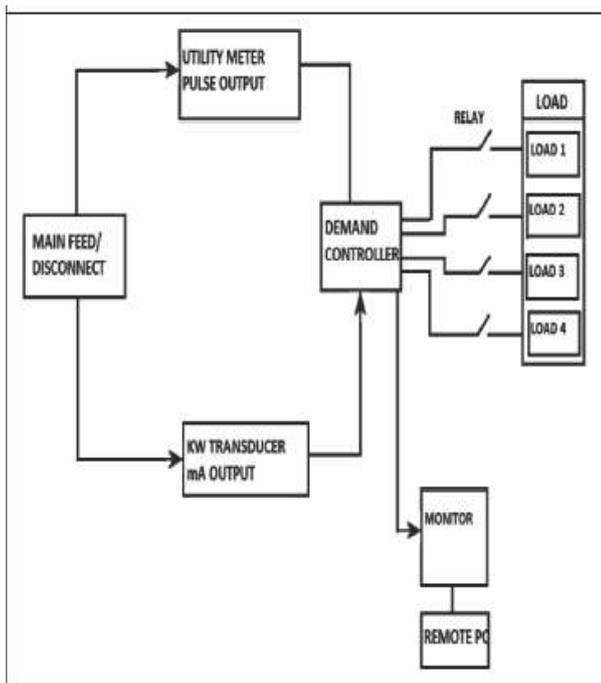


Fig.6 DEMAND CONTROLLER

in a logical sequence. This sequence is predetermined by the user and is programmed jointly by the user and the supplier of the device. The plant equipments selected for the load management are stopped and restarted as per the desired load profile. Demand control scheme is implemented by using suitable control contactors. Audio and visual annunciations could also be used

CONCLUSION

A good record of the load pattern is obtained which enables accurate predictions and better load distribution. The capital outlay for maximum demand control is low. With good maximum demand indication, it is possible to create awareness of where and when power is used and consequently gets greater power utilization. The data obtained from the MDI controller may be used for the design and development of Smart Grid. Helpful for prediction of estimated load in large load dispatch centre. Proper utilization of electrical power during off peak period. The data obtained from the MDI controller is useful for the automation of Distribution system.

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