

电力系统稳定监控的快速数据采集*

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【摘要】 通过对电力系统稳定监控数据要求的分析,依据现有元器件的可实现性,提出了一种能够快速采集电力系统故障及故障前的数据,以保护稳定监控实时性的电路设计方案。

【关键词】 稳定监控 数据采集 实时

引言

随着电力系统的发展,大容量机组、远距离输电的情况越来越多,电力系统的安全稳定运行变得日益重要,系统运行、调度人员迫切需要能快速实时地对系统运行状态是否稳定实行监控。电力系统的稳定监控过程,首先是根据系统可能引起稳定问题的事件,启动稳定分析计算过程,根据分析计算的结果判断系统是否稳定,然后提供相应的控制策略。目前,为了提高稳定监控的实时性,国内外基本都集中在对如何提高稳定分析和计算速度的研究上,而事实上,如果能快速感知到系统发生的事件,在保证系统稳定规定的时间内,将会给稳定分析提供足够的时间,这同样有助于提高稳定监控系统的实时性,而且由于供给稳定分析计算的时间加长,可以进一步保证分析计算的可靠性。因此,快速采集系统事件信息,及时感知系统可能引起稳定问题的事件,对提高稳定监控的实时性和可靠性具有十分重要的意义。本文根据引起电力系统稳定问题的事件时间进程,分析了稳定监控的数据要求,提出了一种能满足大型电力系统稳定监控要求的快速数据采集的电路设计方案。

1 稳定监控的数据要求

导致电力系统发生稳定问题的原因,是由于系统受到大的干扰,使得系统中的发电机失去同步。这些干扰通常是由对系统的常规操作或系统故障所引起的,在产生稳定问题的整个过程中,对于特定的稳定问题,不同的阶段有明确的特征量的变化,如过电压 v 、短路电流 I ,图 1 示出了电力系统遭受雷击发生短路故障并实施控制的时间进程。

从图 1 中可以看出,系统发生故障是从波过程(过电压)开始,接着是短路过程(过电流),然后是系统相应的控制过程,通常人们认为系统故障是从短路过程开始的,即 t_0 时刻,而系统感知到故障的产生是在继电器动作时刻 t_r ,一般 t_r 为几十毫秒到上百毫秒,如果在继电器动作之前能检测到短路过程,并检测出短路电流 I 的大小,将不仅可以提前开始稳定分析计算过程,而且还可以在分析计算过程中直接利用测量的短路电流,免去短路电流的计算;进一步分析,如果能在短路过程之前,检测出波过程,则稳定分析计算过程可以在通常意义下的故障开始之前就启动。

因此,如果能为稳定监控系统及时提供以上各个过程的数据,系统的实时性和可靠性将会进一步提高。要能为稳定监控提供图 1 中的整个过程的数据,采集到波过程的数据是最严格的要求,即只要电路能采集到波过程,电路的特性就一定能满足采集其它过程数据的要求。

通常电力系统的波过程持续的时间在数百微秒到几个毫秒(由输电线路的长度来决定),因此,如果要采集到波过程,采集电路的采样周期必须在微秒级上才能满足要求。

2 快速数据采集电路设计

目前常规的数据采集电路主要有直流采样和交流采样两类,直流采样对系统数据的反应

速度主要受电路的时间常数的影响,一般为几十毫秒到几百毫秒,显然不能满足快速采集波过程的要求;常规交流采样一般为一个周波采集 16 到 20 个点,采样周期在毫秒级上,同样常规的交流采样也不能满足采集波过程的要求。因此要采集满足电力系统稳定监控数据要求的微秒级的数据,目前常规的数据采集电路是无法获得的。

根据电力系统稳定监控的数据要求和现有元器件的可实现性,图 2 给出了电力系统稳定监控快速数据采集电路的设计方案。

图 2 所示的电路结构的采样频率为

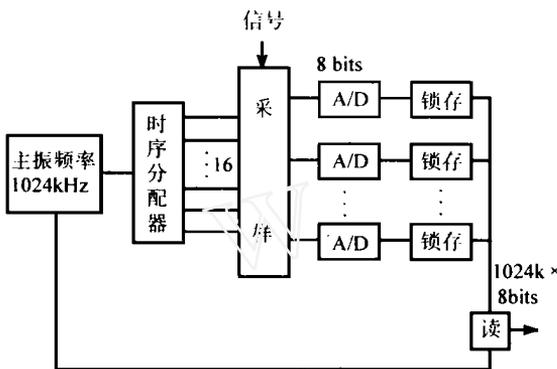


图 2 快速数据采集电路结构

1024kHz,即每一个微秒采集一个数据点,在这样的采样频率下,如果用一个 A/D 转换电路,数据用 8 位表示,则 A/D 转换的速度必须达到 1024k × 8 位/秒,在目前的器件水平下是不可能实现的,因此在电路中增加了一个时序分配器,使得数据按组进行转换,每组中的一个数据由相应的 A/D 转换电路来完成,图中选择的是每组 16 个数据,即时序分配器按 16 个脉冲来分配,其波形如图 3 所示,这样每个 A/D 在每秒中要转换的数据只有原来的 1/16,在器件实现上就容易。

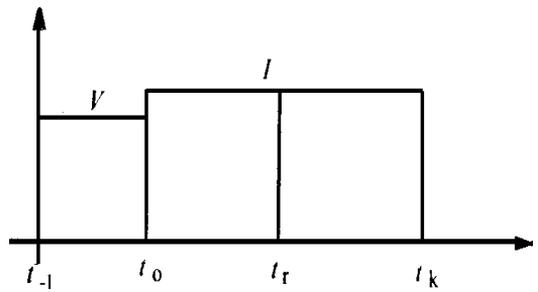
以上电路设计中的主振频率、时序分配脉冲数可以根据实际系统要求来设计。

3 结束语

本文根据电力系统稳定监控的数据要求,提出的快速数据采集电路,不仅能够适应稳定监控快速数据采集的需要,对提高稳定监控的实时性和可靠性有较大的实际意义,而且对于综合自动化系统的数据采集也有一定的实用价值。

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t_{-1} —波过程开始时刻 t_0 —短路开始时刻
 t_r —继电器动作时刻 t_k —开关切除时间

图 1 电力系统短路故障及控制进程

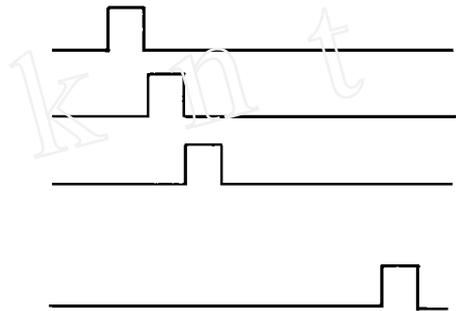


图 3 时序分配器波形

CONTENTS AND ABSTRACTS (Partial)

THEORETICAL STUDY AND APPLICATION

The Influence of Reclosing Instant to CCT Yuan Yuchun, Zhang Baohui(4)

The critical clearing time (CCT) is defined as a given maximum permissible duration of fault before power system loses its stability. In general, CCT regards fault location, fault type and system structure before and after fault. For a given fault the extent of the CCT is decided on the stable region of the system under the fault. It is indicated from analysis on the transient energy function of the system after reclosing, that the reclosing can decrease the transient energy of the system. If the transient energy is decreased to less than that when not reclosing, the reclosing can improve the system's stability. It is indicated from calculation, for the fault at which the system will lose its stability under the second swing, the reclosing is able to heighten the withstanding capacity of the system to the fault. Comparing with that when not reclosing, the CCT of the fault increases importantly.

Keywords: Reclosing CCT

Node Voltage Analysis Method of Fault on Parallel Double Transmission Lines with Multi-Branches Zhang Xiaoyou, Cao Yijiang(7)

Based on the current measured on each terminal of parallel double transmission lines with multi-branches, calculate the node voltages to detect and diagnose fault on the transmission lines. It is proved from simulation that the method is effective.

Keywords: Multi-branch Parallel double transmission line Fault diagnosis

A Measuring Method of Power System Frequency Based on the Fourier Filtering Principle Zhou Damin(10)

An algorithm which uses output of the Fourier filter to measure power system frequency is presented. The algorithm adopts a simplified processing mode to eliminate the influence of different amplitude gains of sine and cosine filters and thus decreases calculation and responding time. Simulation result shows that the algorithm doesn't suffer from voltage zero-cross-point and has a higher measuring accuracy.

Keywords: Frequency Frequency measurement Power system

A New Algorithm of Microprocessor-Based Transformer Differential Protection Huang Chun et al(14)

A new algorithm of microprocessor-based transformer differential protection which uses a principle of cross phase angle method is presented. The algorithm can reliably discriminate internal and external faults of transformer and features less internal memory occupied, less calculations and shorter response time to fault.

Keywords: Transformer differential protection Cross phase angle method Microprocessor-based protection

Fast Data Acquisition of Stability Supervisory Control for Power System Ruan Shuhua, Zhou Buxiang(18)

A circuitry design scheme which can fast acquire pre/post fault data to ensure the real-time of stability supervisory control is presented through the analysis on data requirement of stability supervision control of power system and the availability of existing devices.

Key words: Stability supervisory control Data acquisition Realtime

NEW PRODUCT DEVELOPMENT

Development of XWJK-3000 Open Computer-Based Supervision and Control System Cao Quanxi et al(20)

A computer-based supervision & control system with open system structure is introduced. It uses DSP, PC bus and network technique. It can be used to realize integral automation in 35~220kV substations.

The Study of Microprocessor-Based Stability and Control Device Applied in Fengbai System Zhang Tao et al(23)

A new type of microprocessor-based device based on-the-spot is introduced. The device deals with the voltage of busbar and the current of transmission lines which are connected to the device. The device detects type of fault by means of the voltage and current and trips generators according to the settings. The hardware and software of the device are mainly described. Today, the device is applied in Dongfeng substation, Meihe substation, Hadawan substation and Fengman hydropower plant of Fengbai power system.

Analysis on the Technical Features of YTF(S)-500 Remote Trip Signal Transmission Device Zhu Yanzhang, Wang Kuipu(27)