Application Note Abstracts

Thyristors (SCR's and Triacs)

AN-3551 . . . . . 6 pages
Circuit Factor Charts for RCA Thyristor Applications

In the design of circuits using thyristors, it is often necessary to determine the specific values of peak, average, and rms current flowing through the device. This Note contains charts that show several current ratios as functions of conduction and firing angles for some SCR and triac circuits. Examples are given of the use of these charts in the design of half-wave, full-wave ac, full-wave dc, and three-phase half-wave circuits using RCA thyristors. Current and voltage waveforms for the various circuits are included, as are curves of per-cent ripple in load current and voltage.

AN-3659 . . . . . 6 pages
Application of RCA Silicon Rectifiers to Capacitive Loads

This Note describes a simplified rating system that allows designers to calculate the characteristics of capacitive-load rectifier circuits quickly and accurately. The effect of the addition of a series limiting resistance to such circuits and the importance of the ratio of the limiting resistance to capacitive reactance are described; curves of rectifier current ratios are presented as functions of the effective ratio. Typical design examples are given, and output-ripple considerations are discussed.

AN-3697 . . . . . 8 pages
Triac Power-Control Applications

This Note describes triac operating characteristics and provides guidance in the use of triacs in specific applications: incandescent lamp controls, light-activated controls, motor controls, heat controls, and a proportional integral-cycle control.

AN-3778 . . . . . 6 pages
Light Dimmers Using Triacs

A simple, inexpensive light-dimmer circuit that contains a diac, triac, and RC charge-control network is described. The use of the diac to trigger the triac in light-dimming circuits is explained. The basic light-control circuit is introduced and its operation described. In addition, the components added to improve circuit performance are discussed. Three complete circuits and parts lists are shown for 120-volt, 60-Hz operation and 240-volt, 50/60-Hz operation. Mechanical details involved in building the circuits are discussed, and a trouble-shooting chart is included.

AN-3822 . . . . . 6 pages
Thermal Considerations in Mounting of RCA Thyristors

Three simple rules to aid the designer in determining heat-sink specifications for a given application are provided. Power dissipation and heat-sink area, the mounting of thyristors on heat-sinks, typical heat-sink configurations, and chassis-mounted heat-sinks are discussed.

AN-3886 . . . . . 6 pages
AC Voltage Regulators Using Thyristors

This Note describes a basic ac-voltage regulating technique using thyristors that prevents ac rms or dc voltage from fluctuating more than ±3 percent in spite of wide variations in input line voltage. Load voltage can also be held within ±3 percent of a desired value despite variations in load impedance through the use of a voltage-feedback technique. The voltage regulator described can be used in photocopying machines, light dimmers, dc power supplies, and motor controllers (to maintain fixed speed under fixed load conditions).

AN-4124 . . . . . 8 pages
Handling and Mounting of RCA Molded-Plastic Transistors and Thyristors

Detailed guidelines for handling and mounting plastic-packaged RCA power transistors and thyristors are given. Types of packages and suggested mounting hardware to accommodate various mounting arrangements are described. Recommendations are made for handling packages during the forming of leads. Various mounting arrangements, thermal considerations, and cleaning methods are described. This information is intended to supplement the data on electrical characteristics, safe operating area, and performance capabilities in the technical bulletin for each type of plastic-packaged transistor or thyristor.

AN-4242 . . . . . 16 pages
A Review of Thyristor Characteristics and Applications

This Note describes the operation, ratings, characteristics and typical applications of thyristors. The basic operation of a thyristor is explained by use of a two-transistor anology. The significance of voltage and temperature ratings is pointed out. Thyristor gate characteristics, switching behavior, and triggering techniques are described. Use of thyristors in typical power-control applications is discussed.

AN-4537 . . . . . 8 pages
Thyristor Control of Incandescent Traffic-Signal Lamps

This Note discusses the use of thyristors in the control of traffic signals. The thyristor most applicable to this application is the triac, which can carry the electrical power required for incandescent traffic-light bulbs, yet can be gated by the low-power signals from electronic control timers or monitoring computers. In addition, the triac is able to handle the large transient currents that result from cold filament turn-on (inrush) and filament rupture (flash-over). Triac operation, stresses on triacs in operation with incandescent lamps, and a number of triac circuits for control of incandescent lamps in traffic signal applications are discussed.

AN-4745 . . . . . 6 pages
Analysis and Design of Snubber Networks for dv/dt Suppression in Thyristor Circuits

When a triac is used to control an inductive load, voltages with high rates of change (dv/dt) can be generated that can cause a non-gated turn-on of the triac. The result is a loss of control of power to the load. The simplest method of suppressing this dv/dt stress is to place a series RC network across the main terminals of the triac. The design of this network, commonly called a snubber network, must take into account the peak voltage that can be allowed in the circuit and the maximum dv/dt stress that the device can withstand. This Note analyzes the RC network design and contains graphs that allow a designer to select a snubber to fit a given application.

AN-6054 . . . . . 6 pages
Triac Power Controls for Three-Phase Systems

The growing demand for solid-state switching of ac power in heating controls and other industrial applications has resulted in the increasing use of triac circuits in the control of three-phase power. This Note explains a basic approach to the design of triac control circuits for use in the switching of three-phase power. The basic design rules employed in this approach are outlined, an integrated-circuit zero-voltage switch specifically intended for use in triac triggering is briefly described, and the necessity for, and methods of isolation of, the dc logic circuitry in power controls for three-phase systems are pointed out. Recommended configurations are then shown for power-control circuits intended for use with both inductive and resistive balanced three-phase loads, and the specific design requirements for each type of loading condition are discussed.

AN-6096 . . . . . 8 pages
Solid-State Approaches to Cooking-Range Control

As a result of decreasing semiconductor costs, advanced system-cost analysis by appliance manufacturers, and increased consumer consciousness, various solid-state range-control designs can be applied in today's applicance market. This Note presents various solid-state design approaches available to the range-control designer.

AN-6141 . . . . . 6 pages
Power Switching Using Solid-State Relays

Solid-state relays make use of a semiconductor device for control of ac or dc power. Since, in most ac applications, the semiconductor element chosen for power control is the triac, this Note describes the triac as a power-switching element. Advantages and disadvantages of the active element over the electro-mechanical relay are discussed in general terms. Basic parameters, such as surge in-rush capability, transient-voltage ratings, suppression network, turn-off consideration and the different modes of triac gating are also discussed. AC power control is covered by various circuit designs for ON/OFF control, zero-voltage switching, and line-voltage isolation.

ICAN-6182 . . . . . 28 pages
Features and Applications of RCA Integrated-Circuit Zero-Voltage Switches (CA3058, CA3059 and CA3079

RCA-CA3058, CA3059 and CA3079 zero-voltage switches are monolithic integrated cir-

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cuits designed primarily for use as trigger circuits for thyristors in ac power-control and power-switching applications. These integrated-circuit switches operate from ac input voltages of 24, 120, 208 to 230, or 277 volts at 50, 60, or 400 Hz. Zero-voltage switches trigger the thyristors at zero-voltage points in the supply-voltage cycle. Consequently, transient load-current surges and radio-frequency interferance are substantially reduced. Zero-voltage switches also reduce the rate of change of on-state current (di/dt) in the thyristor being triggered and can be adapted for use in a variety of control functions by use of an internal differential comparator to detect the difference between two externally developed voltages.

AN-6286 . . . . . 8 pages
Latching, Gate-Trigger Circuits Using Thyristors for Machine Control Applications

This Note describes a variety of approaches to the development of a solid-state, latching gate drive for the control of ac loads; the solid-state device used is the thyristor. The solid-state circuits described have fewer undesirable characteristics than electro-mechanical devices and are smaller and lighter.

AN-6288 . . . . . 2 pages
Thyristors in Capacitive Discharge (CD) Ignition Systems

This Note describes the requirements of small-engine ignition systems (those deriving electrical energy from a flywheel alternator system), automotive or battery-powered systems, and the ac line-operated igniters. The merits of both capacitive and inductive systems are compared. Both systems are described in terms of performance and limitations. Practical circuits are shown.

AN-6438 . . . . . .24 pages
Surge Capability of SCR's, Triacs, and Rectifiers

This Note provides the designer with an easy way to derive, from the published sinusoidal capability of any semiconductor, its triangular surge capability for stress durations between 0.5 and 20 milliseconds, and thereby helps him select the most suitable fuse to protect the semiconductor of interest.

AN-6452 . . . . . 16 pages
A New Practical Fuse-Thyristor Coordination Method

This Note describes the possibilities of protecting a semiconductor by fusing—when and how a fuse can be used and how much protection is afforded. Cases for which fuse protection is not possible, or for which only partial protection is feasible are also discussed. Fuse selection methods are described.

AN-6456 . . . . . 12 pages
Characteristics and Applications of RCA Fast-Switching ASCR's

Silicon controlled rectifiers (SCR's) used in applications such as inverters, choppers, and radar pulse modulators at switching frequencies up to 30 kHz require high di/dt and dv/dt capabilities and very short turn-on and turn-off times. This Note explains SCR characteristics required for fast-switching applications, describes a new type of fast-switching SCR, the asymmetrical silicon controlled rectifier (ASCR), and discusses the application of this new type of SCR in induction cooking ranges.

AN-6605 . . . . . 16 pages
Application of RCA Power Devices in Off-Line, High-Frequency Inverter/Converter Circuits

The current trend in power inverter/converter design is to use high-frequency switching techniques and direct operation off the available utility lines (i.e., 110 or 220 volts). The use of higher operating frequencies reduce the magnetic materials required and the size of the filter capacitors. This Note discusses the use of RCA power transistors and SCR's in selected high-frequency inverter/converter applications.

AN-6628 . . . . . 8 pages
Design and Application of High-Power Ultrasonic Converters Using ASCR's

Asymmetrical SCR's with maximum turn-off times of 4 microseconds make possible high-power ultrasonic converters operating at 10 kilowatts at a very competitive price. This Note describes the ASCR structure, explains the basic design principles of an ASCR converter, and discusses the application of this converter to electronic arc-welding equipment and industrial power supplies.

AN-6671 . . . . . .16 pages
Characteristics and Turn-off Circuit Considerations for RCA GTO Silicon Controlled Rectifiers (G4000)

This Note describes the RCA G4000 family of gate turn-off devices designed primarily for automotive and dc switching applications. The description consists of a qualitative discussion of device switching, physical structure, and general applications. Turn-off circuit designs are also discussed. Ratings and characteristics are covered in the appendix.