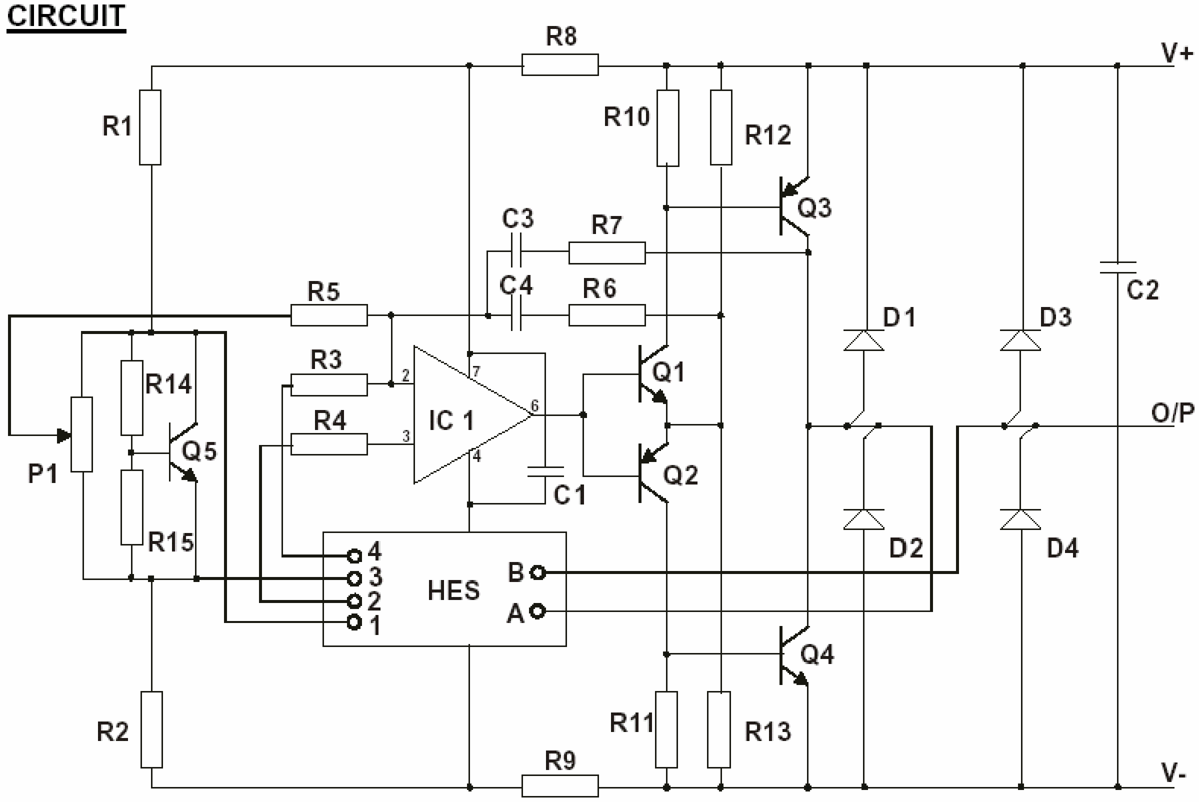
Speciality Magnetic Components
QUALIFIED to ISO 9001:2008

UPDATE FOR HES200 HR AND HES500 HR

Units in the TELCON HES range incorporate the coil and hall element from similar devices in the TELCON HTP range of Hall Effect Current Transformers. They are supplied as a free-standing component, enabling the user to configure a closed-loop Hall effect transformer to their own specification.

This Application Note updates our earlier note to realise the full capabilities of the HES200 HR and HES500 HR. The maximum output from the buffer that drives the coil and burden resistor in the standard application circuit is typically ±12V. This places a limit on the maximum current that can be fed through the coil especially if a high value burden resistor is used. The circuit shown can provide a ±14V drive and will under worst case conditions provide an accurate measurement of a 700A rms sine wave current with a burden of 12 ohms or less from the HES500 and a 250A rms sine wave current from the HES200 with a burden of 18 ohms or less.

CIRCUIT



The circuit shown above and the component values given below are similar to those used in the corresponding units in the TELCON HTP/HT range.

RESISTORS

R1/R2 – 2k2	R3/R4 – 1k2	R5 – 100k
R6 – 22k	R7 – 1M	R8/R9 – 10R
R10/R11 – 2k2R12/R13 – 1k8		R14 – 3k
R15 – 6k8		P1 – 5k TYP

CAPACITORS

C1/C2 100nF, 50V min., Ceramic.
C3 47pF, 50V min,, Ceramic.
C4 100pF, 50V min., Ceramic.
When using the circuit with primary currents with high di/dt or high dV/dt, ensure op-amp and output transistors are physically close to each other and C1.

SEMICONDUCTORS

IC1 OP-37 or NE5534. The Hall effect current transformer is the sum of a current amplifier with a top limit of frequency response and an air-gapped transformer which becomes a "better" current transformer at higher frequencies. Use of these op-amps ensures a comparatively "seamless" combination.
D1, D2 & D3, D4 BAT49
Q1/Q5 2N2222 Q2 2N2907 Q3 TIP32 Q4 TIP31

ZERO OFFSET ADJUSTMENT

Zero adjustment is necessary to remove zero errors due to the offsets in the Hall element and the input of the op-amp. The most straightforward is to use a potentiometer (pot), P1, to adjust the output to zero when no primary current is flowing. Using this method, the output can be readily set to within ±30μA of zero or closer.
Another method that can be used in computer, or microprocessor-controlled systems, is to set a nominal zero by replacing the pot P1 with a pair of equal value resistors, monitor the output at times of known zero current, and correct for the measured value.

NOTES FOR EXTENDED OPERATING TEMPERATURE

The Hall element used in these devices is specified over the temperature range -20°C to 100°C. The manufacturer guarantees that they function over the range -40°C to 100°C but does not provide maximum limits on various parameters such as offset drift over this range, only typical figures. Because they are manufactured from a narrow band semiconductor, the changes in the characteristics with temperature are more marked at lower temperatures than at higher temperatures and changes over the -40 to +20°C range are typically 4 to 8 times those over the range 60 to 80°C. When used in a closed loop configuration, the only characteristic likely to cause problems at low temperatures indicate that at -40°C a change in the offset over its 25°C value of up to 10mV at a Hall Element supply voltage of 1.4V is likely to occur in a small minority of samples. This equates to an offset in the primary current of about 1.2A. Since it is impractical to measure every unit at low temperature, this figure cannot be guaranteed.

At high temperatures the principal problem is the overheating of the Hall Element. The sensitive element is small with a high thermal resistance and therefore undergoes substantial self-heating with relatively small input currents. In the recommended constant voltage mode, the decrease in element resistance with temperature leads to increased current and increased self-heating. This can lead to thermal runaway. The power dissipation from the coil and the magnetic losses in the core can raise the temperature of the Hall Element by up to 15°C above ambient so that the maximum allowable voltage across the element falls linearly from 2V at 25°C to 1V at 80°C. Reducing the Hall Element voltage to 1V, with the R14/R15/Q5 combination as shown, will have little effect on the closed loop performance of the sensor provided the input errors of the op-amp used to sense the Hall voltage are still small compared with the proportionally reduced error and sensitivity of the Hall Element at the lower drive voltage. An OP37 is a suitable device for this purpose. Limiting the available current from the Hall Element voltage supply to 8mA is a useful precaution against thermal runaway.