Transarc DC 630/800/400E

PCB Operation

See explanation on simplified drawing concerning majority of operation, ie. firing thyristors, waveforms etc.

Open Circuit Detector

When not welding - 80V from B4 (arc sensing) holds transistor Q2 off. The +15V through the R9/R23 network then fires Q5 resulting in IC2 output pin 14 being clamped to OV. The main thyristors are therefore not fired.

When welding commences, the output from B4 reduces to arc voltage, Q2 now switches on, this switches off Q5 and V ref (reference level J) is now available to fire the thyristors.

Please Note:

Gate pulses can therefore only be checked when the machine is loaded.

Voltage Reference (Reference Level J)

Depending on the mode selected ie. local/remote a signal is applied through the relevant logic switch to IC2 pin 13. The output signal from this device normally being clamped by Q5 when not welding.

When not welding +15V is applied through R102/R101 to the inverting inputs of the firing angle comparators, (taking one only for this description) ie. top one on the drawing IC5 pins 6,5,7. On the non inverting input is a ramp (this as explained in the simplified instructions) therefore at this time the output from IC5 pin 7 is OV.

When welding commences Q5 releases IC2, output pin 14 a negative voltage is now applied to pin 10 of IC3. The output of IC3 pin 8 will now go less positive and the signal applied to IC5 pin 6 will now intersect with the ramp on pin 5, a squarewave signal will not exit pin 7 to fire the thyristors.

Current Feedback (Voltage Compensation Circuit)

This is sensed across shunt SH1 connection B2 and B3 and applied to the shunt amplifier IC13. The negative output of IC13 being summed with V ref resulting in a less positive signal causing the thyristors to be fired later, thus reducing the output.

Hot Start

When not welding as stated above transistor Q2 is off. The +15V is then also applied through the R9/R12 network to IC1 pin 5 switching on the device, a voltage is now present at pin 3 which charges capacitor C77. When welding commences Q2 is fired switching IC1, capacitor C77 now rapidly discharges through R25. This increases the ref signal for a short period and therefore the output.

Short Circuit Detector

At short circuit, when the arc goes very low, the output of IC2 pin 7 will switch from positive to OV this causes transistor Q3 to switch off. Output will now be available through time constant R26/C9/R27 which will increase V ref for a short period, ie. until the short circuit is removed.

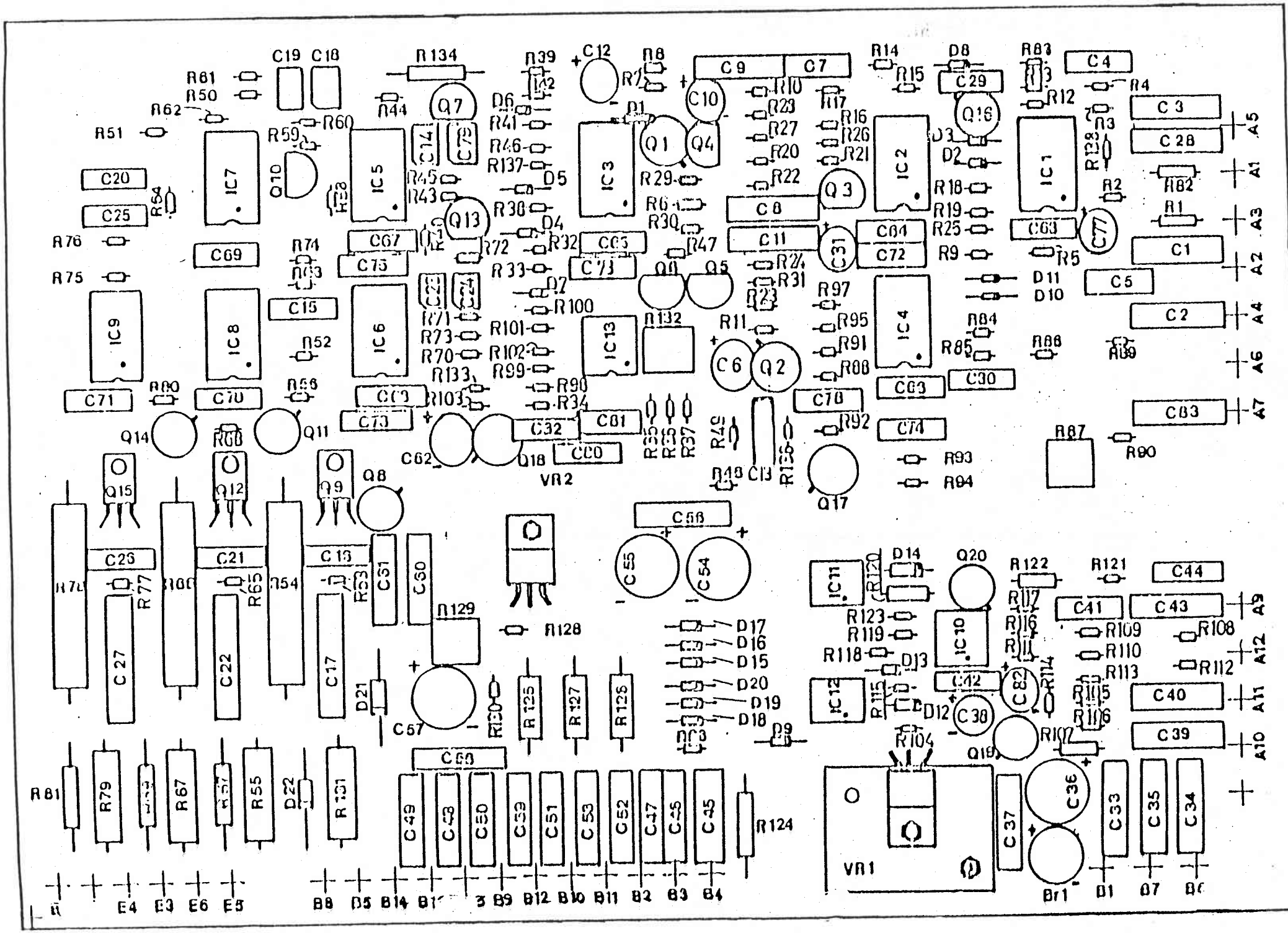
Fold Back

If the electrode stubs down ie. B4 (arc sensing goes down to OV, IC2 output pin 7 will switch to -15V. Q4 then conducts reducing the ref voltage to OV which switches off the thyristors.

TIG Operation

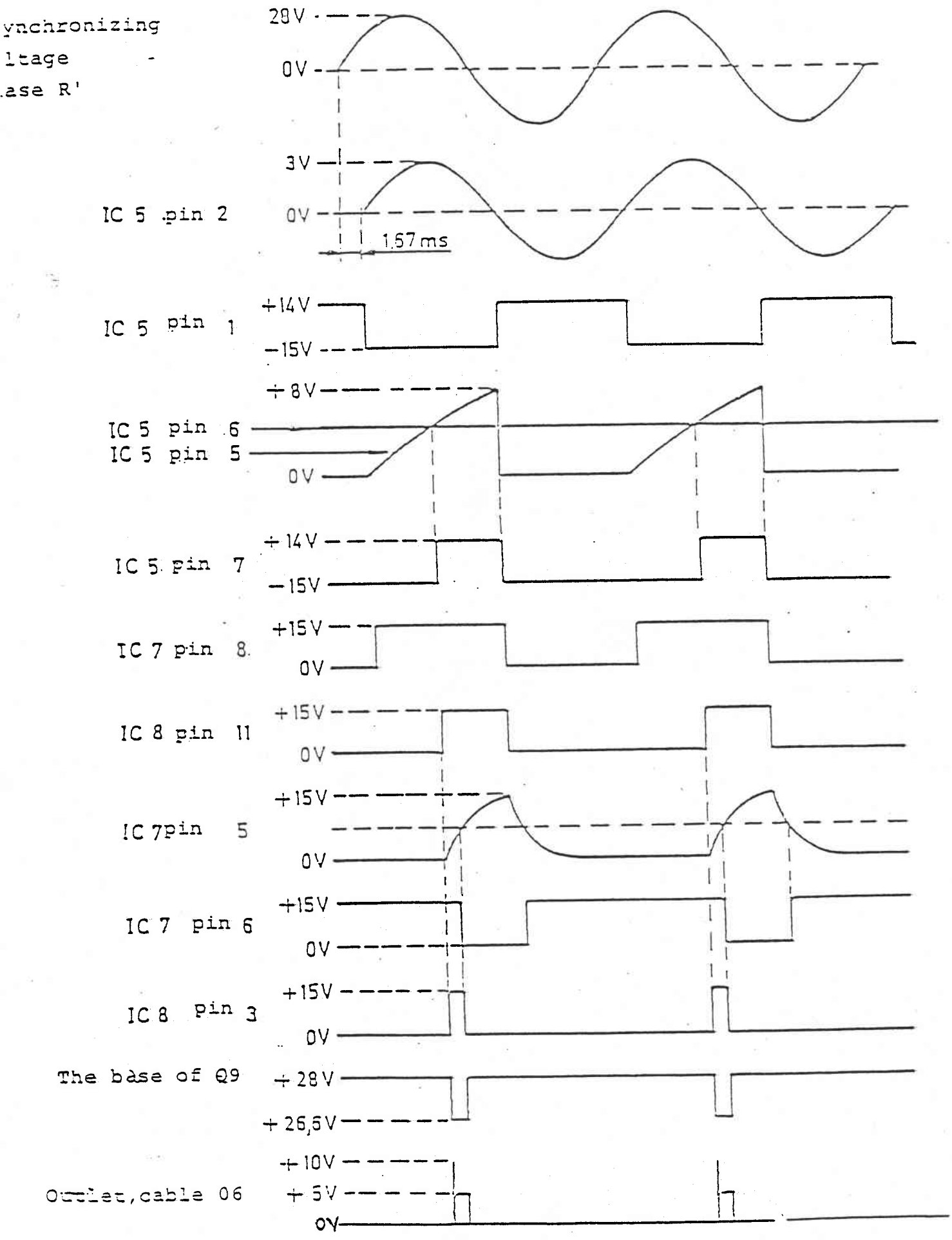
With the MMA/TIG switch set to the TIG position transistor Q16 is energised which ensures electronic switch IC1 pins 4-3 are always open. This ensures no hot start operation in this mode. Also because transistor Q16 is on there will be no short circuit detector or fold back operation.

DC 630/800 - PCB LAYOUT



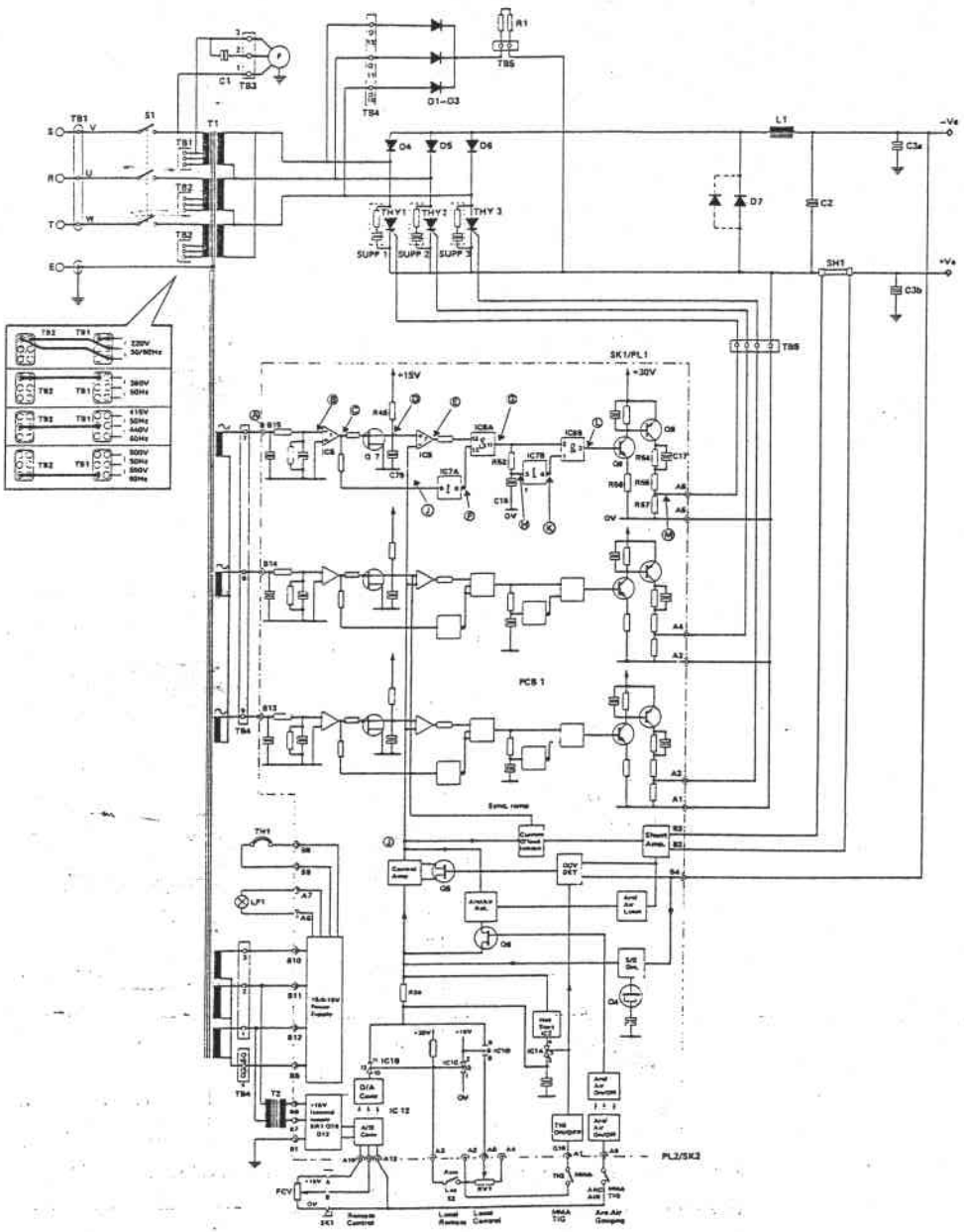
WAVE FORMS IN TRIGGER UNIT ON TRANSARC PC_BOARD

DC630/800



DC 400E/DC 630/800

SIMPLIFIED DRAWING



CIRCUIT DESCRIPTION

Switching on
Mains input tappings are selected on TB1 and TB2 as shown in the inset. When ON/OFF switch S1 is pressed the a.c. input supply is connected to T1 and fan F rotates.

T1 outputs supply the thyristor bridge, synchronising inputs to the thyristor control circuits and input to the 15–0–15V power supply.

Welding Supply
The thyristor/diode bridge circuit (THY 1, 2,3, D4 D5 & D6) rectifies the incoming a.c. supply, and output current is drawn via the inductance L1 and shunt SH1.

Shunt SH1 'samples' the output current and senses any changes or fluctuations due to mains input variations or changes in welding conditions.

The value of welding current, (plus any variations) is fed back to the control circuit board.

Voltage feedback is taken from the negative line to the p.c.b. via B4 to sense 'open circuit' and 'stub down' conditions.

Diodes D1,2 & 3 maintain a rectified output during a.c. crossover periods i.e., whilst the a.c. waveform is passing through zero and thyristors have insufficient firing potential. This maintenance current ensures that the arc is not extinguished during these periods, thus resulting in an improved welding characteristic.

Output Current Control.
The firing angle of thyristors THY1,2 & 3 is controlled by the control circuits as described below. A reference level 'J' controls the firing angle and is derived either from the local current control RV1 or the remote control unit (RCU).

Local Control
With the Local/Remote switch S2 in the 'Local' position, 0V from A2 is connected via A3 to IC1B—pin 12 and IC1C—pin 13 so inhibiting the remote control circuit and by switching off IC1C allowing +15V to switch on IC1D at pin 8. RV1 then provides a reference level to the control amplifier.

Remote Control
Switching to 'Remote' removes the OV from A3 allowing IC1B—pin 12 and IC1C—pin 13 to rise to +25V. IC1D—pin 8 goes low switching off local control. IC1B—pin 12 goes high and switches on remote control.

The foot control unit (FCU) is connected, via SK1, A10, A11, A12 to the analogue—to—digital (A/D) convertor. This circuit is a pulse oscillator running at 2.8KHz whose pulse ratio varies with d.c. input, it is optically linked to the D/A convertor via an opto-isolator.(IC12).

Thyristor Control Circuits
The firing angle of thyristors THY1, 2 & 3 is controlled, each in turn, by three identical circuits. This description deals with the control circuit for THY1 (IC5, Q7, IC7, Q8 Q9).

Waveforms 'A' to 'M' show the generation of thyristor firing pulses in relation to the a.c. waveform applied to the thyristors. The reference level 'J' controls the firing angle.

'A' A synchronising waveform is applied to input B15. This waveform is approximately 28V a.c. in amplitude.

'B' The waveform is shifted to match the phase angle of the start point of the thyristors. The amplitude of the waveform at this point is approximately 3Va.c.

'C' IC5 is a zero crossing detector and the output at pin 1 is a squarewave the edges of which are synchronised with the a.c. crossover points.

'D' Q7, R45 & C79 form a ramp generator rising from 0V to approx. +8V.

'E' IC5 compares the 0 to 8V ramp with the reference d.c. level 'J' and produces pulses at pin 7 the width of which are proportional to the d.c. level of 'J'.

It can be seen that, when 'J' is 'low' the pulses are wide; when 'J' is 'high' the pulses are narrow.

Notice also, that as the reference level is lowered or raised, it is the leading edge of the pulse which changes angle (earlier or later compared to the original a.c. waveform). The trailing edge remains static and synchronised to the zero crossover.

'L' The leading edge of 'E' is used to create 2mS pulses which are 'early' or 'late' as previously described. These pulses are shaped by the 2mS Pulse Generator (IC7, and IC8) as described below.

'M' Q8 and Q9 form a pulse amplifier whose output at A5/A8 controls the ON/OFF firing of Thyristor THY1.

'N' This waveform represents the original phase-shifted a.c. as applied to the thyristor with the firing time of the thyristor shown shaded.

Hence the higher the reference level 'J' the less thyristor conduction time and the less the welding current output. The lower the reference level the longer the thyristor conducts and the higher the output welding current.

Pulse Amplifier Q8/Q9
The pulse applied to the base of Q8 drives it into conduction. The negative going Q8 collector switches on Q9 and the resulting positive-going pulse appears across R57.

At this instant C17 short circuits R54 resulting in a 'spike' which ensures positive firing of the thyristor.

2mS Pulse Generator
'F' & 'G' The output from the zero crossing detector 'C' is inverted by IC7A and the inverted waveform 'F' is used to hold pin 12 of IC8A at +15V whilst pin 13 of IC8A follows waveform 'E'

'H' R52 and C15 provide an integrated waveform at pin 5 of IC7B which reaches the threshold level of IC7B after 2mS.

'K' At this 2mS point IC7B switches from +15V to 0V and remains there until waveform 'H' falls below the threshold level.

'L' Pin 3 of IC8B follows waveform 'G' leading edge up to +15V and is 'switched off' after 2mS by waveform 'K'. This waveform is used to produce the firing pulses 'M' as previously described.

Output Monitoring

Current Feedback – from SH1 via B2 and B3 exercises some control of the reference level 'J' to offset minor fluctuations. The overload current circuit, which is supplied with a synchronised ramp signal from the firing circuit, inhibits the reference level should the output current rise above 800Amps. (J goes to +14V). At lower extremes of current (below 8Amps) an output from the shunt amp. switches on the OCV detector.

Voltage Feedback– from the negative output terminal is fed to the OCV detector via B4. When the OCV rises, for a period longer than 100mS. The detector switches on Q5 lowering the reference level 'J' to zero (maximum output).

Short Circuit Detector– When 'stub down' is detected, the short circuit detector gives a momentary rise in reference level in an attempt to free the electrode.

If normal control is not established within 300mS, Q4 conducts and reduces the reference level to approx. –1V, and welding output is reduced to zero.

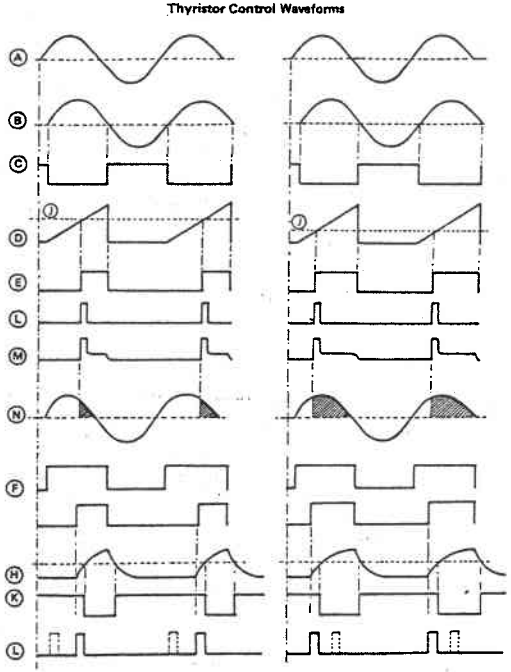
TIG/MMA Selection
When the TIG/MMA switch is closed (in the TIG position) 0V is applied to the TIG ON/OFF circuit which provides a –15V inhibit voltage to switch off the hot start short circuit detector, and OCV detector circuits.

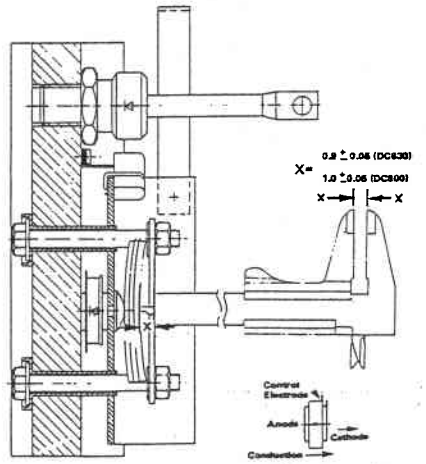
ARC AIR Gouging
With the MMA/TIG/ARC AiR Gouging switch in the ARC AiR position, 0V from A12 activates the opto-isolator resulting in Q6 being switched on.

The arc air reference circuit now bypasses the control amp. and adds a higher value to the normal reference level.

The reference circuit is inhibited by the arc air limiter (to protect the machine) under short circuit conditions.

Thyristor Control Waveforms





Thyristor Fitting Instructions

Replacing the thyristors

When fitting a thyristor it is most important that the correct torque force be applied, and that the mating surface of the heat sink and the thyristor is absolutely clean and free from sharp edges. Smear the connecting surface of the heat sink with a very thin coating of heatsink compound or silicon grease.

Fit the thyristor with the rectifier symbol on the thyristor facing in the direction shown opposite. The thyristor is centered by means of a guide pin. First, tighten the nuts by hand, making sure that there is no play between washers and nuts. Then, using a vernier caliper, measure the distance from the plate to the spring as shown. Finally, tighten the nuts alternatively with a wrench until the measurement is 0.9 ± 0.06mm, (DC630) and 1.0 ± 0.06mm (DC800).