FERRANTI 255, 355 and 455

a.m.-f.m. receivers

MODEL 255 is a 5+1 valve table radio for a.c. mains, covering m.w., l.w. and f.m. bands. Model 355 is a radiogram version using a Collaro RC54 or Garrard RC110 autochange unit and output via a 10in. dia. speaker. Model 455 is a bureau-type autochange radiogram with output via twin 8in. speakers and using a modified audio section.

CIRCUIT DETAILS

A.M. Reception

The signal input is conveyed via front and rear wafers of the wave-change switch section 4, to the grid of V2A operating as mixer. Signals are tuned by L11, C21 (m.w.) or L12, C22, C23 (l.w.) with C25, C26, main tuning gang. V2B is a conventional tuned grid local oscillator; L17/L18 m.w. transformer, L19/L20 l.w. transformer, trimmed by C38 and C39 respectively.

The i.f. signal (470 kc/s) is fed via L13/L14 to the i.f. amplifier V3. The a.m. and f.m. transformers are connected in series; when set is switched to a.m., the reactance at 470 kc/s of the f.m. transformer primary L15 is an effective short circuit; when switched to f.m., the reactance at 10.7 Mc/s of C31 is so low as to represent an effective short circuit. Harmonics of the local oscillator (a.m.) appear around 10.7 Mc/s and to prevent absorption and loss of gain L16 is short circuited when set is switched to a.m. bands.

The amplified i.f. signal is then fed to a diode of V4, via L21/L22, and is demodulated, the a.f. voltage appearing across the load R18/R19 being fed via section 1 (rear) of the wave-change switch to the volume control R25, thence to the triode section of V4. The d.c. component present in the output of the demodulator is fed back, via filters, to V2A and V3 as a.g.c. bias.

The amplified a.f. signal is then fed to V5, a conventional power output valve with negative feedback and a manual tone control (R34) in the coupling network. Power is provided by means of a full-wave mains rectification system of conventional a.c. design.

F.M. Reception

Signal input is fed via r.f. transformer L1/L2 to the cathode of V1A, operating as a grounded grid r.f. amplifier, the output of which is fed to the oscillator feedback coil L4 via L3 and C4. The tapped coil L4, with C7 and the V1B grid-cathode capacitance, form a simple bridge network.

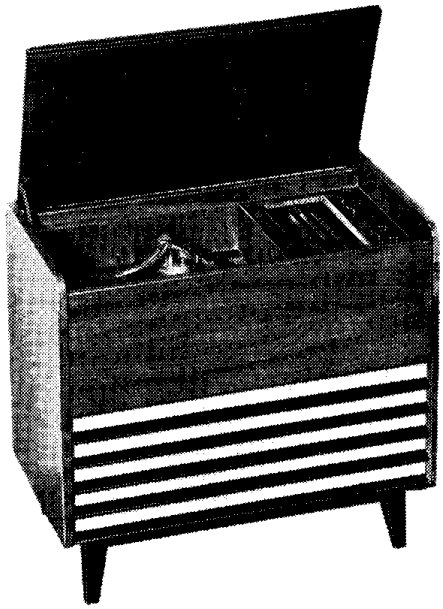
C7 is adjusted to balance the bridge at the mid-oscillator frequency so that oscillator voltage at L4 tap is reduced to a minimum and so reduces oscillator radiation via C4 to the r.f. and aerial circuits.

I.f. signals at 10.7 Mc/s are developed across L6. The decoupling resistor R4 is only partially bypassed by C3 so that a portion of the i.f. signal appears at the junction of R4 and C3. This signal is coupled back via L3-C4-L4 into the oscillator grid, it is amplified and appears across L6 to reinforce the original signal. Thus, V1A functions both as mixer-oscillator and regenerative i.f. amplifier.

On f.m. operation, V2A functions as an i.f. amplifier, the output of which is coupled via L15/L16 to the 2nd i.f. amplifier V3 which is driven into grid current, resulting in amplitude limiting and producing a negative bias which tends to maintain a constant output. A d.c. voltage which varies with average carrier level is derived from the ratio detector and applied to G3 of V3 to assist the a.g.c. action.

Two diodes of V4 are arranged in a ratio detector circuit, fed from the discriminator transformer L23/L24. The demodulated output is fed via the tertiary winding on the discriminator transformer, de-emphasis and a.f. load components and the switch to the volume control and thence to the audio stages as for a.m. operation.

Model 255



Model 355

RELEASE DATES AND PRICES
Model 255T: Sept., 1956; 25 gns.
Model 355RG: Sept., 1956 59 gns.
Model 455RG: Sept., 1956, 79 gns.
All prices tax paid.

SERVICE SNAPS

FERRANTI 255, 355 and 455

Valves: Models 255 and 355—ECC85, ECH81, EF85, EABC80, EL84, EZ80. Model 455—ECC85, ECH81, EF85, EABC80, ECC82, two EL84, GZ32.

Dial Lamps: Models 255 and 355—two 6.3V 0.2A. M.E.S. Model 455—three 6.5V 0.3A.

Intermediate Frequencies: A.m.—470 kc/s. F.m.—10.7 Mc/s.

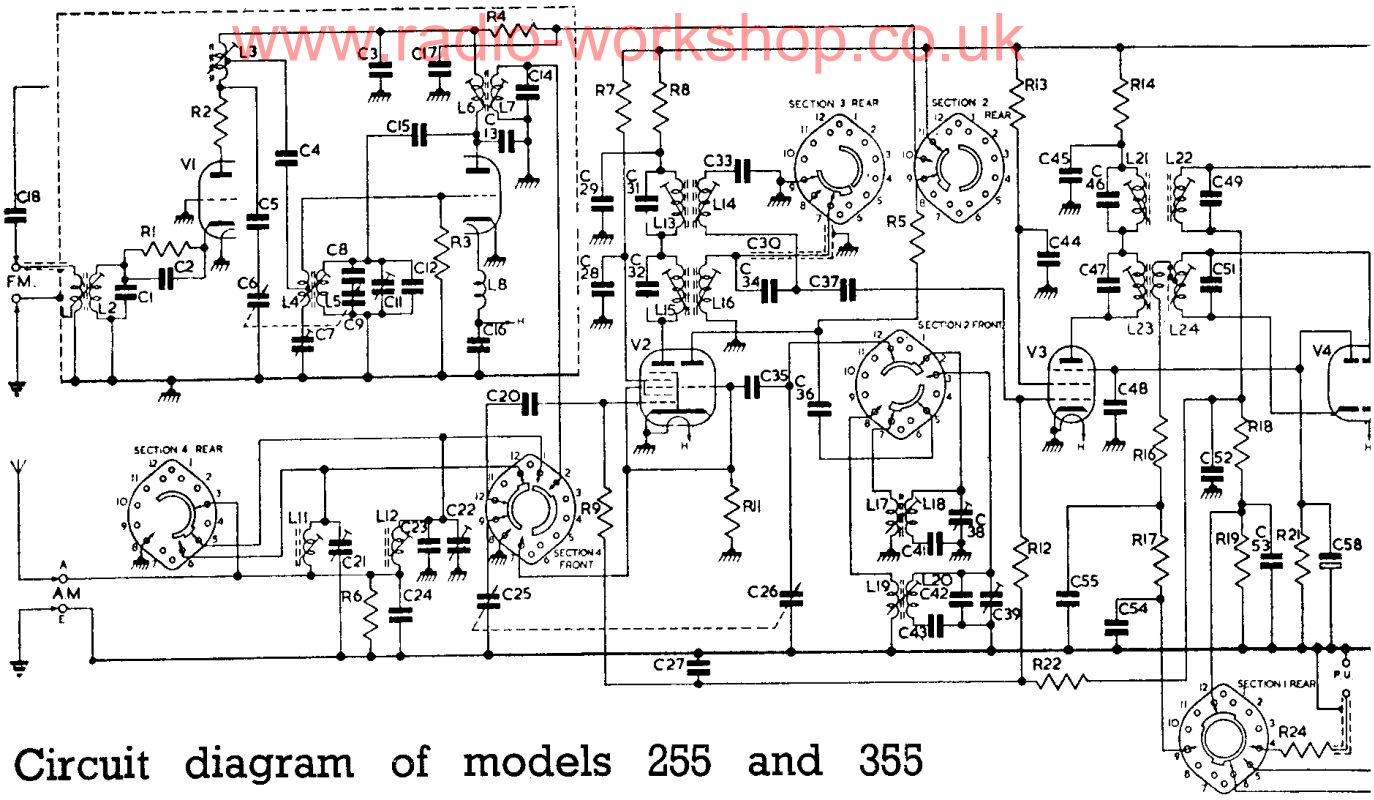
Volume Control: 1MΩ log. (Models 255 and 355), 1MΩ log, tapped at 200kΩ (Model 455).

Tone Control: 500kΩ inv. log with d.p. switch (Models 255 and 355), or 1MΩ lin. with d.p. switch (Model 455).

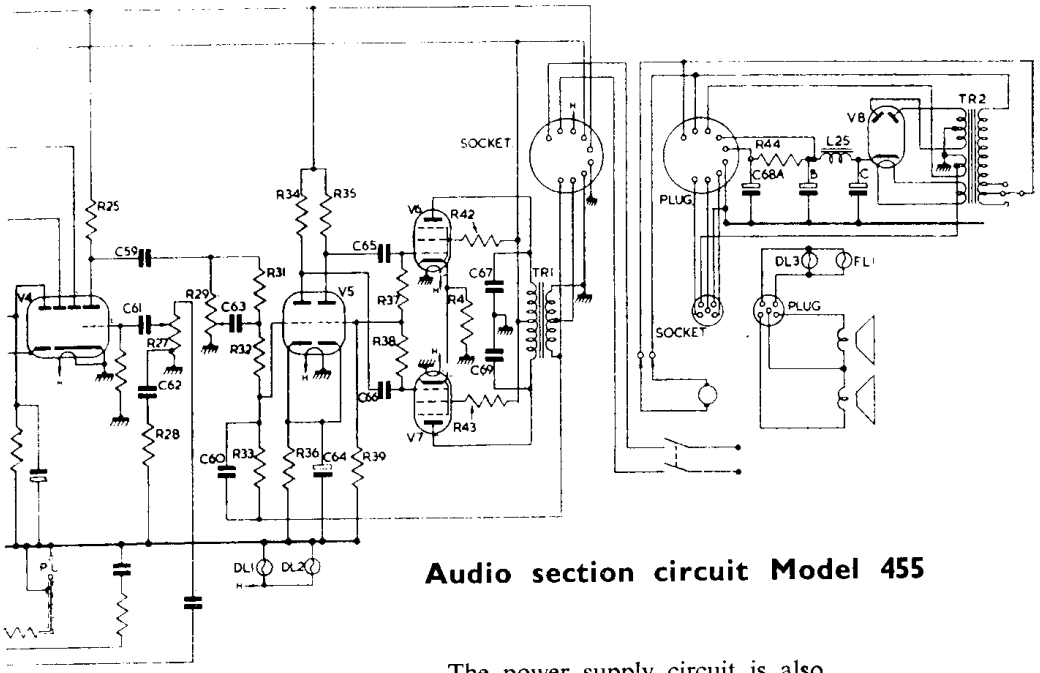
Electrolytics: 5μF, 50V; 25μF, 25V; 32 - 32μF, 350V (Models 255 and 355) or 24 - 24 - 16μF, 350V (Model 455).

Wavebands: 190-570m (m.w.), 1,000-2,000m (l.w.) and 87.5-100 Mc/s (f.m.).

Mains input: 200-250V a.c. only.



Circuit diagram of models 255 and 355



Audio section circuit Model 455

Model 455

This bureaugram version is exactly the same as Models 255 and 355 up to the triode section of the EABC80, V4. The output from V4 is fed to a double-triode phase splitting stage V5 (ECC82) which drives a pair of EL84's in push-pull.

The power supply circuit is also slightly different as shown above. The high h.t. line feeds, in addition to the output valve screens, the V3 and V2A anodes. The lower h.t line feeds the remainder of the anodes and screens of the pre-detector stages.

New component values are shown alongside.

VALVE VOLTAGES AND CURRENT

	Anode		Screen		Cath
	V	mA	V	mA	V
V1A	160	6	—	—	1.5
V1B	160	6	—	—	—
V2A	225	2.7	70	5	—
V2B	85	4.5	—	—	—
V3	220	7	53	1.8	—
V4*	70	0.5	—	—	—
V5	265	40	230	4.5	6.3
V6	—	—	—	—	280

*Triode section

On f.m. operation voltages are slightl lower than figures quoted above, anod and screen currents slightly higher. O f.m., V2B anode is disconnected from h.t on a.m. V1 is disconnected from h.t., o gram V1 and V2B anodes are disconnecte

Readings taken with Model 8 Avomete Smoothed h.t. at low end of R31—230V Total h.t. current at V6 cathode 65m (a.m.) or 70mA (f.m.).

Resistors

R25	100kΩ
R27	1MΩ*
R28	100kΩ
R29	1MΩ
R31	470kΩ
R32	100kΩ
R33	330kΩ
R34	100kΩ
R35	100kΩ
R36	1.5kΩ
R37	390kΩ
R38	390kΩ
R39	470kΩ
R41	130Ω, 1W
R42	100Ω
R43	100Ω
R44	2.2kΩ, 1W

*Tapped at 200kΩ.

Capacitors

C59	0.01μF
C61	0.01μF
C62	0.0
C63	3
C64	25μF,
C65	0.0
C66	0.0
C67	0.00
	400V
C68A	24μF,
C68B	24μF,
C68C	16μF,
C69	0.00
	400V

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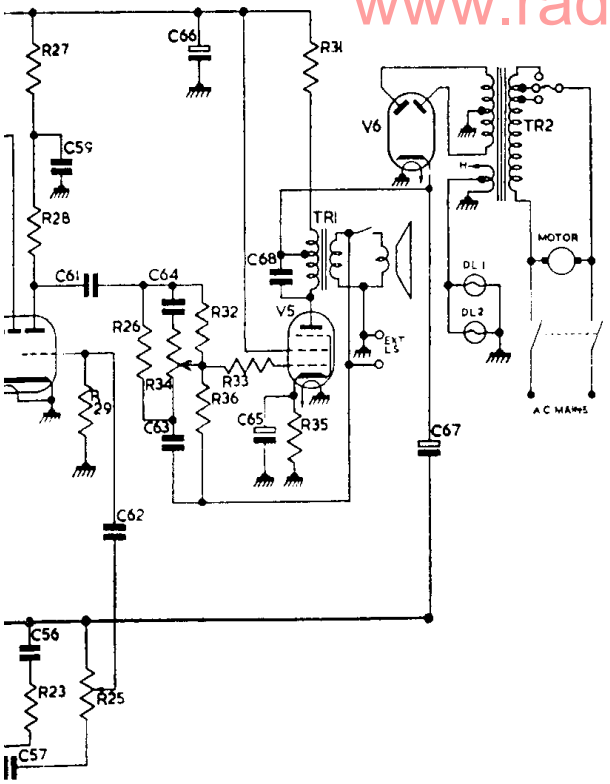


COMPONENT LIST

Capacitors

C1	5pF
C2	0.002μF
C3	680pF, 5%
C4	50pF, 5%
C5	25pF, 5%
C6	gang
C7	2.75-15pF
C8	50pF, 5%
C9	gang
C11	0.5-5pF
C12	5.6pF
C13	10pF, 5%
C14	20pF, 5%
C15	15pF, 5%
C16	0.001μF
C17	0.001μF
C18	10pF
C20	200pF
C21	3-40pF
C22	3-40pF
C23	75pF, 5%
C24	0.005μF
C25	gang
C26	gang
C27	0.05μF
C28	0.005μF
C29	0.005μF
C30	20pF
C31	100pF, 5%
C32	33pF, 2%
C33	200pF, 5%
C34	200pF, 5%
C35	50pF
C36	200pF
C37	50pF
C38	3-40pF
C39	3-40pF
C41	430pF, 1%
C42	150pF, 5%
C43	200pF, 2%
C44	0.005μF
C45	0.005μF
C46	100pF, 5%
C47	33pF, 2%
C48	0.002μF
C49	300pF, 5%
C51	40pF
C52	100pF
C53	100pF
C54	0.001μF
C55	300pF
C56	0.005μF
C57	0.01μF
C58	5μF, 50V
C59	0.05μF
C61	0.005μF, 500V
C62	0.005μF, 500V
C63	0.002μF, 500V
C64	200pF
C65	25μF, 25V
C66	32μF
C67	32μF
C68	0.005μF, 400V a.c.

Capacitors 350V wkg unless otherwise stated.

Resistors

R1	220Ω
R2	10Ω
R3	1MΩ, ½W
R4	4.7kΩ, 1W
R5	33kΩ, 1W
R6	3.3kΩ
R7	33kΩ, 1W
R8	2.2kΩ
R9	1MΩ
R11	47kΩ
R12	220kΩ
R13	100kΩ, ½W
R14	2.2kΩ
R16	47Ω
R17	39kΩ
R18	220kΩ
R19	470kΩ
R21	27kΩ
R22	1MΩ
R23	47kΩ
R24	220kΩ
R25	1MΩ
R26	470kΩ
R27	100kΩ
R28	220kΩ
R29	10MΩ
R31	1.8kΩ, 4W
R32	220kΩ
R33	100kΩ
R34	500kΩ
R35	150Ω, ½W
R36	470kΩ

All resistors ¼W unless otherwise stated.

Valves

V1	ECC85
V2	ECH81
V3	EF85
V4	EABC80
V5	EL84
V6	EZ80

PRODUCTION MODS

F.M. Sensitivity

In later models, C3 is 390pF and C5 is 50pF, these changes giving increased sensitivity on f.m. operation. In introducing these changes to earlier receivers, C3 leads must be kept very short and the earth connection made to the end of the capacitor marked with a black band.

Re-trimming of the r.f. circuits will be necessary to correct calibration. In a few receivers, low gain when using the internal aerial may be due to short-circuit by the aerial strip of C18 due to the positioning of the tag panel on which C18 is mounted.

Crackles

In later models, the dial lamp circuit is earthed via a lead from the dial lamps to a chassis earth tag. Where crackles are experienced, due to poor contact between lamp holders and dial assembly, the lead should be added.

Record Changer Noise

Later models using the RC54 record changer are fitted with a cushion spring on the striker feed lever to prevent the rhythmical tapping noise caused by the auto trip lever. A spring and fitting instruction can be obtained from the Ferranti service department for earlier grams in which the noise is apparent.

Alignment Procedure

When carrying out full realignment, the a.m. circuits should be trimmed before the f.m. circuits, as follows:

I.F. Alignment

Inject 470 kc/s into pin 2 of V2 via 0.1 μF capacitor and with receiver tuned to 2,000m (maximum l.w.) tune L22, L21, L14 and L13 for maximum gain, taking first peak as core is screwed in.

R.F. Alignment

Tune receiver to 500m, inject signal of 600 kc/s to aerial socket via standard dummy aerial and adjust L17/L18 and ring on L11 for maximum output. Tune receiver to 200m, inject 1,500 kc/s and trim C38 and C21 for maximum output. Repeat.

Tune receiver to 1,800m, inject 166.6 kc/s and trim L19/L20 and ring on L12 for maximum output. Tune receiver to 1,128m, inject 266 kc/s and trim C39 and C22 for maximum. Repeat.

Note that aerial rod rings should be resealed with wax after alignment.

F.M. ALIGNMENT

I.F. Circuits

Method 1: Using a.m. signal generator connected to f.m. aerial sockets, 10V d.c. high resistance meter across R21 for i.f. alignment and a 100V a.c. meter across TR1 primary or a 3V a.c. meter across speaker for discriminator (L24) alignment. Signal input to be kept about the level to give about 5V across R21 or 10-20V across TR1 or 1.2V across speaker.

Unscrew core of L24 to nearly fully out. Inject 10.7 Mc/s and trim L23, L16, L15, L7 and L6 for maximum volts across R21. Inject 10.7 Mc/s, modulated 30 per cent, and trim L24 to *minimum* dip between two peaks.

To check bandwidth, detune signal generator in equal steps of, say, 50 kc/s up to 200 kc/s above and below the i.f., recording output voltage across R21 at each step and graphing results. Response

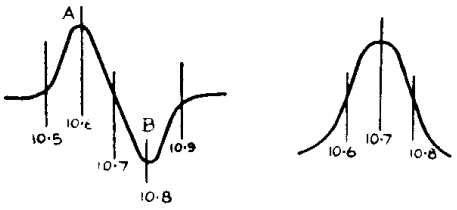


Fig. 1 (Left): Discriminator "S" response curve. Fig. 2 (right): Pre-detector i.f. response curve.

shape must be substantially symetrical and voltage at 10.6 and 10.8 Mc/s should be approximately 6dB below voltage at 10.7 Mc/s.

Method 2: Using f.m. signal generator, deviation ±75 kc/s, with 1 kc/s tone modulation.

Unscrew L24 core nearly fully out and trim all i.f. circuits as before. Then tune L24 for *maximum* audio output obtainable with minimum distortion. Slight mis-tuning can be detected on either side of the correct tuning point as sharp increase in distortion.

An oscilloscope can be connected across audio output to indicate correct tuning point for L24, the core of which should lie centrally between the two points where distortion occurs as indicated by marked flattening on peaks.

Method 3: Using f.m. oscillator (±300 kc/s deviation), the output of which is fed to receiver aerial sockets, and an oscilloscope whose sweep waveform (about 150V d.a.p. at 50 c/s) is used to modulate the signal generator, the amplifier being connected to volume control for discriminator response or to V3 anode via suitable probe for i.f. response.

An a.m. signal generator is also required, in parallel with f.m. oscillator, to provide calibration markers, unless this facility is available in f.m. oscillator.

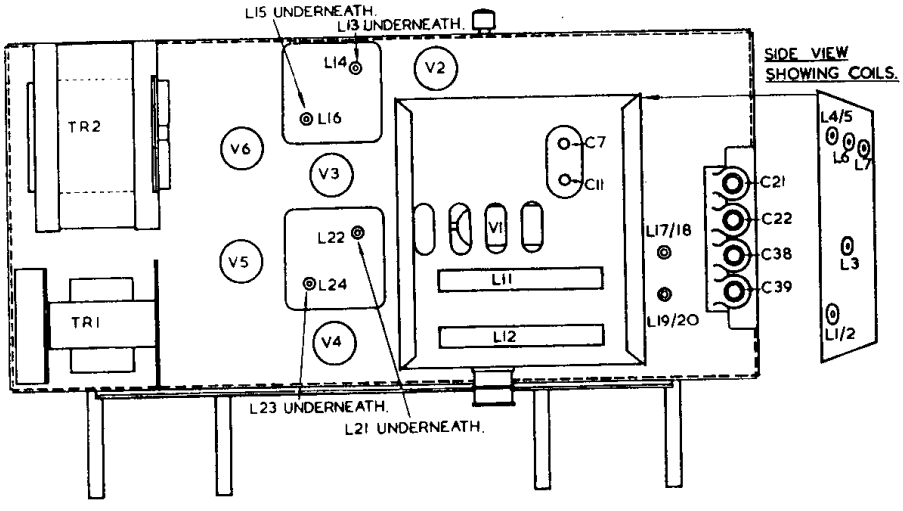
Tune receiver to about 94 Mc/s and signal generator to 10.7 Mc/s, adjusting attenuator so that waveform trace on 'scope is about 0.2V d.a.p. (Fig. 1). Section of trace between A and B should be linear and symetrically centred on 10.7 Mc/s; non-linearity is affected by L24, centring by L23, the adjustments being somewhat interdependent. Slight readjustment of i.f. cores may be necessary for optimum results.

If desired, the pre-detection i.f. response can be independently examined by transfering c.r.o. amplifier input connections to V3 anode via diode probe. Response is shown in Fig. 2.

R.F. Circuits

Inject 90 Mc/s signal into f.m. aerial socket, using either a c.w. signal with a 10V d.c. meter across R21 or a ±25 kc/s f.m. signal with output indicator across TR1 or speaker. Adjust L4/L5 for maximum gain.

Retune receiver and signal input to 98 Mc/s and trim C11. Repeat 90 and 98 Mc/s trimming. Then retune to 94 Mc/s and trim L3.



Sketch of receiver chassis from above, with side view of r.f. unit, showing location of trimming positions.

INCORRECT ALIGNMENT

If receiver is correctly trimmed, a marked dip in interference will occur when station is correctly tuned in. Poor noise rejection or distortion indicates incorrect setting of L23 and L24, causing poor linearity and/or assymmetry of response characteristics.

OSCILLATOR RADIATION

After extensive repairs, adjustment may be necessary to reduce oscillator radiation. Remove screening box and connect valve voltmeter (maximum f.s.d. 1V with short probe leads) between junction of L3/C4 and chassis. Tune receiver to 94 Mc/s and adjust C7 for minimum indication first minimum as core is screwed in.

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