CONSUMER MICROCIRCUITS LTD

PRODUCT INFORMATION
FX407A - FX407S - FX507A - FX507S - FX607N
5-Tone Sequential Code Transceivers for Selective Call Systems

Obsolete Product
- For Information Only -

Publication D/407/507/607/2 March 1984

Features

- Digital Tone Filters
- Sinewave Output
- Group Call Facility
- Automatic Transpond Facility
- Programmed Frequencies
- Direct Decimal Coding
- Constant Bandwidth
- Operates in High Noise Conditions

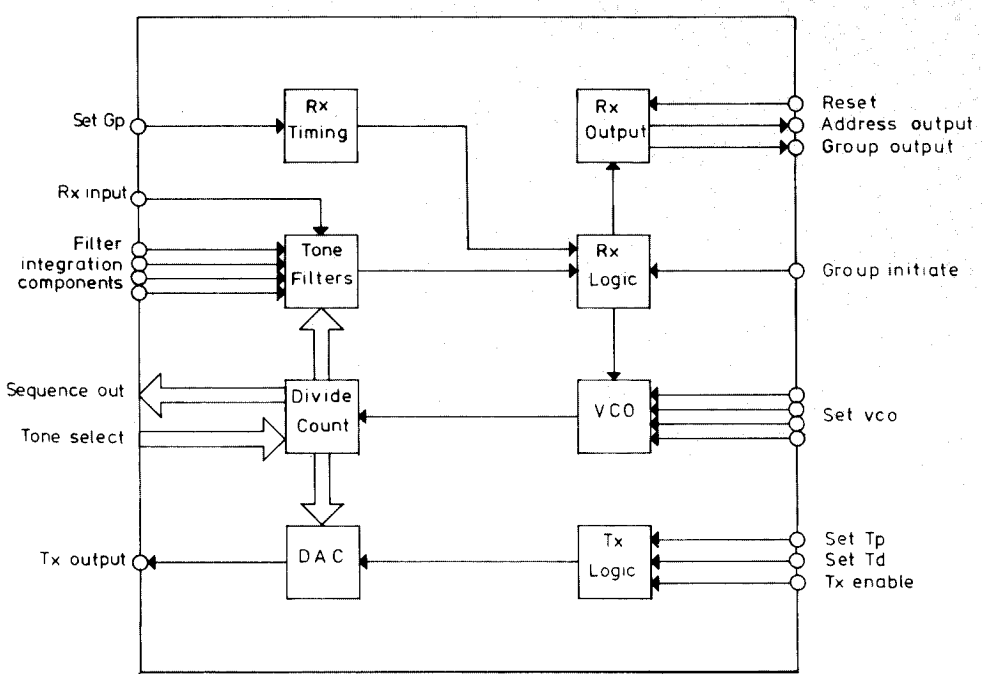


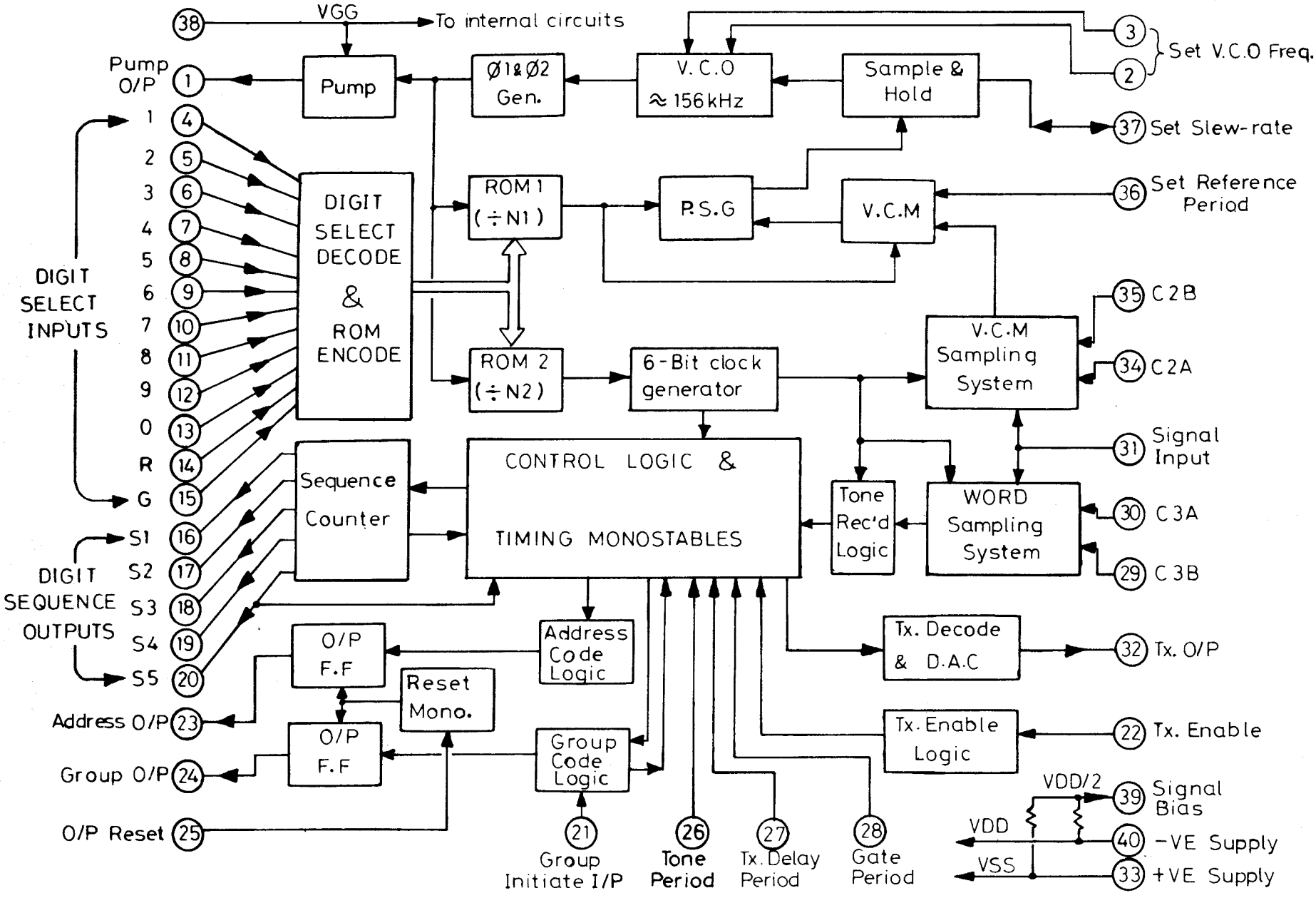
Fig. 1 Functional Schematic

FX407A
FX507A
FX407S
FX507S
FX607N

These MOS/LSI monolithic circuits are fully operational 5-tone sequential code decoders/encoders, designed for use in selective calling systems using International Frequency Standards. Each device incorporates tone filters and tone generator circuits on chip and is pre-programmed to the II tone frequencies specified by the appropriate standard. A 12th frequency is included which allows group calling functions to be carried out using groups of 10, 100 or 1000 receivers. The FX407A & S are programmed for CCIR tones, the FX507A & S are programmed for ZVEI tones and the FX607N is programmed for NATEL tones. The 'S' versions of the 407/507 can decode input tones of unequal lengths.

Careful attention has been paid to operation of the tone decoders under high noise signalling conditions and specially developed digital filtering techniques are employed which permit operation under adverse signal to noise ratios. The filter circuits have a constant bandwidth over a wide dynamic signal range.

SIMPLIFIED BLOCK SCHEMATIC



GENERAL OPERATION

Code programming is performed by external pin linking (direct decimal coding) and up to 100,000 codes can be programmed in this manner. Coding can be varied for receive and transmit functions and facilities are included for automatic transponding of a reply code, on receipt of the correct Address. When transmitting tones, the device generates a pseudo-sinewave consisting of incrementally stepped output levels. The output waveform has a low harmonic content and is suitable for direct modulation of transmitters.

A call number (Address code) is programmed by linking the Digit Sequence switches, S1 thro' S5, to the required Tone Digit Select inputs, 0 thro' 9. A choice of 2, 3, 4 or 5 tone call numbers may be programmed. A common code, or different codes, can be programmed for receive and transmit functions. The decoder gate period, i.e. the maximum time allowed for receipt of consecutive digits in the Address code, is set to the required value by components RS CS.

On receipt of the preset code, the decoder Address output is switched ON. The switch is latched ON until manually reset by open circuiting the Reset pin, alternatively, connecting a resistor/capacitor to the Reset pin causes automatic turn-off after a predetermined time has elapsed.

In transmit mode, the programmed code is sent once for each TX Enable input instruction (1→0 logic level). Tones are transmitted in uninterrupted sequence until the code is completed, the duration of each tone being set by components RT CT. Each code transmission is preceded by an adjustable delay interval, set by components RD CD, to allow special user timing rules to be met.

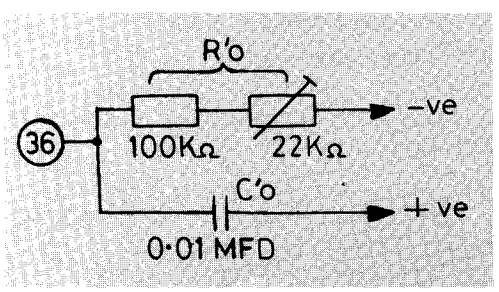
By permanently grounding (VSS) the TX Enable pin, automatic transponding is obtained. i.e. the encoder section transmits each time the decoder receives the correct address. No transpond occurs when a Group code is received.

5-tone Group calling is obtained by connecting the output of a FX-105 single tone filter switch, tuned to the 12th tone 'G', to the Group Initiate logic input. Provided the input code contains the correct first two digits of the Address, inclusion of the 'G' tone at appropriate points in the remaining digits activates decoders in groups of 10, 100 or 1,000.

Decode and encode tone frequencies are obtained by dividing a high frequency clock (VCO) which is locked to a multiple of a low frequency reference (VCM).

The Tone Digit Select inputs are logic gates which insert correct division factors for the selected tone, absolute accuracy is determined by the VCM.

VCM Timing Components



Period (T'ref) = 0.7 R'0 C'0 (sec)
Standard T' ref for CCIR & ZVEI tones
= 0.788 milliseconds.
Standard T' ref for NATEL tones
= 1.055 milliseconds

TONE FREQUENCIES

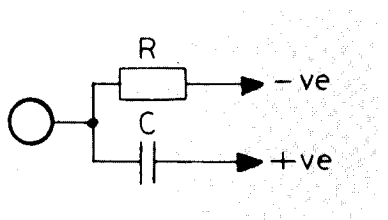
The FX-407, 507 and FX-607 are similar circuits differing in the internal division factors selected by the Digit Select inputs. The tone frequency index of each type is given below.

PIN Nº	4	5	6	7	8	9	10	11	12	13	14	15
DIGIT.	1	2	3	4	5	6	7	8	9	0	R	G
Type FX-407 based on C.C.I.R. tone frequencies.												
Hz	1121	1200.5	1278	1357	1444	1541	1638	1747	1856.3	1983	2113	2401
Type FX-507 based on Z.V.E.I. tone frequencies.												
Hz.	1057.5	1163	1269	1402	1530	1665.5	1828	2001	2203	2403	2601	2796
Type FX-607 based on NATEL tone frequencies												
Hz	631	697	770	852	941	1040	1209	1336	1477	1633	1805	1995

CODE TIMING

The decoder Gate period (Gp), encoder Tone period (Tp) and TX Delay (Td) are adjustable between a few milliseconds and several seconds by selection of RS CS, RT CT and RD CD. If a function is not required, e.g. TX Delay = zero, use minimum specified RC values. Do not delete components, or circuit may latch-up.

Code Timing Components



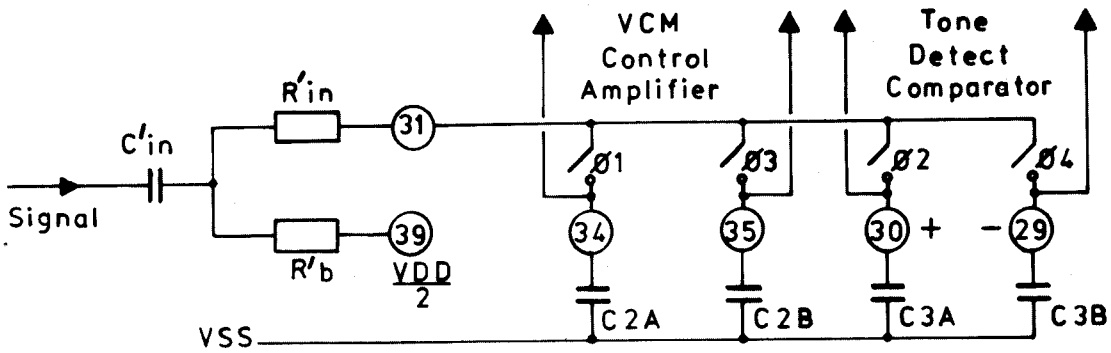
Period = 'K'RC (seconds)
Tone Period: where K = 0.6, R = RT, C = CT
Rx Gate Period: where K = 0.65, R = RS, C = CS
Tx Delay Period: where K = 0.65, R = RD, C = CD
(R = Meg-ohms C = MFD)

Component values for standard CCIR/ZVEI/NATEL timing are listed below, values are for Gp = 2Tp and Td = Gp, where Tp = 100mS (FX-407) and 70mS (FX-507 & 607) For most applications, component tolerances of +/— 5% are suitable. For 'S' versions Gp = Tp.

Period	FX—407	FX—507/607
Tp (Tone period)	RT = 360KΩ CT = 0.47MFD	RT = 360KΩ CT = 0.33MFD
Gp (Gate period)	RS = 680KΩ CS = 0.47MFD	RS = 680KΩ CS = 0.33MFD
Td (TX Delay)	RD = 680KΩ CD = 0.47MFD	RD = 680KΩ CD = 0.33MFD

Component limits: R = >100KΩ < 5MΩ C = >100pfd < 5.0MFD

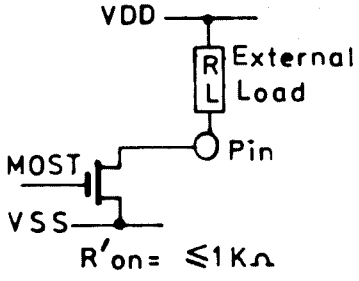
SIGNAL INPUT

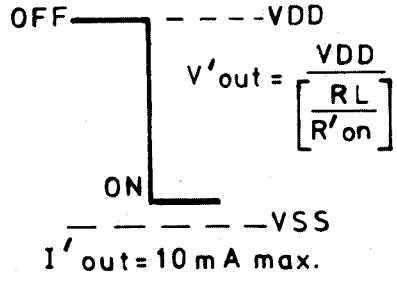


Components: C' in = 0.01 MFD 10%, R' in = 330 KΩ 10%, R'b = 330KΩ 10%
C2A = C2B = 470pfd 10% each.
C3A = C3B = 0.01 MFD 10% each. (Use up to 0.1MFD 10% each in high noise conditions)

R'in C2 and R'in C3 form sampling integrators. Increasing C3 increases filter Q(higher broadband noise rejection) but gives an increased response time. Increased tone amplitude reduces response time. Values stated for 0.1V to 1V RMS and standard tone lengths.

OUTPUT SWITCHES (Address and Group O/P's Pins 23 & 24)

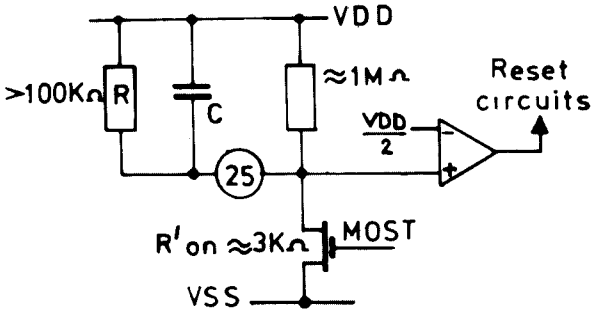




Note:
Open drain configuration allows outputs to be linked for wired-OR operation.

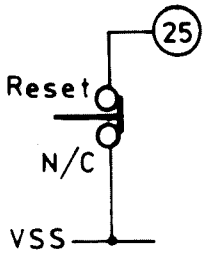
OUTPUTS RESET (Common reset for Address & Group O/P's)

MONOSTABLE (T'on ≈ 0·65 RC sec)



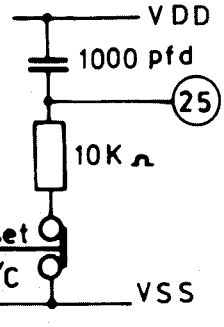
(Outputs OFF at power-up)

MANUAL 'A'



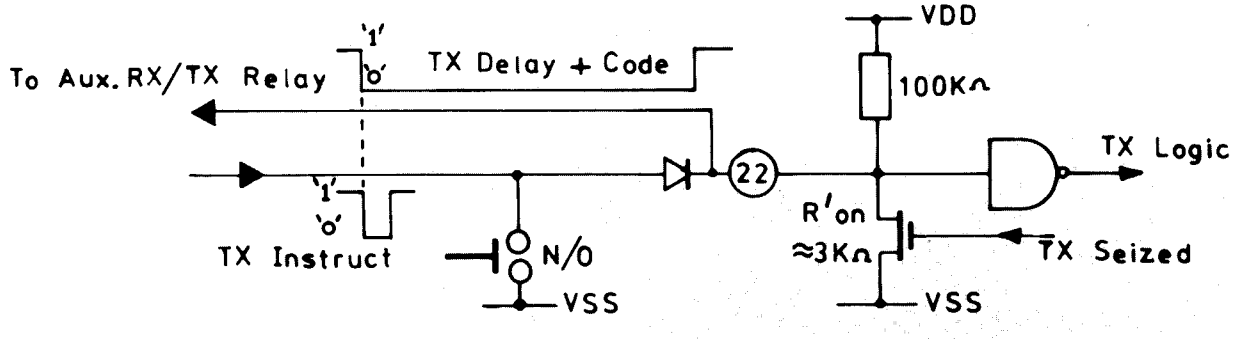
[Outputs ON at power-up]

MANUAL 'B'

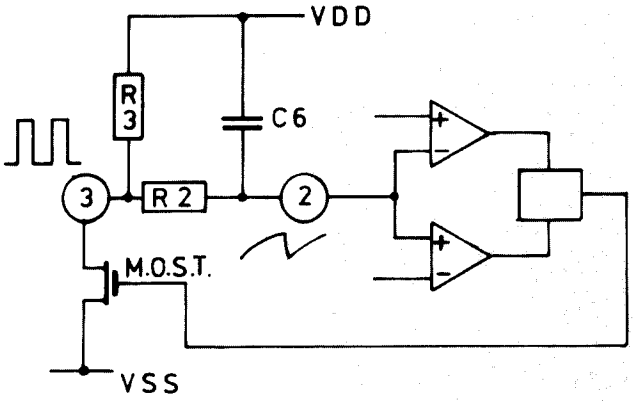


(Outputs OFF at power-up)

TX ENABLE



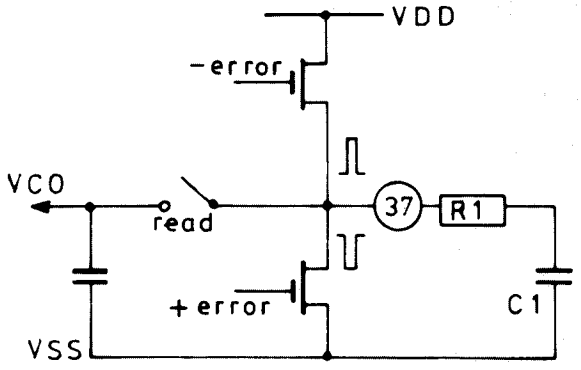
VCO



R2 = 100KΩ 5%
R3 = 22KΩ 5%
C6 = 68pfd 5% (100pfd 5% for 607N)
Nominal VCO frequency is ≈ 156 KHz

Note: Keep pin wiring short.

SLEW RATE

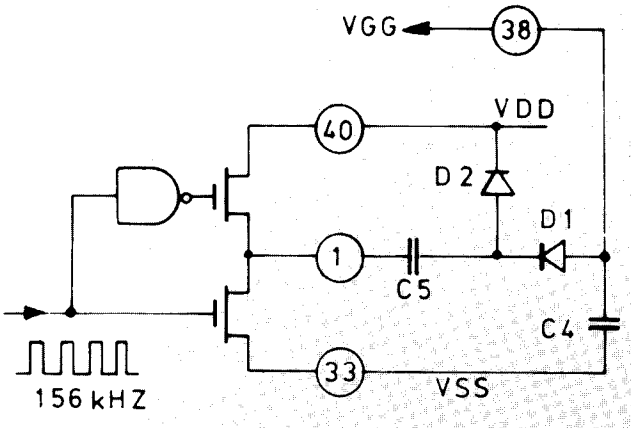


Error between VCO and VCM frequency ratio is integrated in R1 C1, and read out to correct VCO. RC too small causes frequency instability, RC too large causes slow shift to next tone.

Nominal values:
R1 = 100KΩ 10%
C1 = 0.022MFD 10%

Note: Keep pin wiring short.

VGG PUMP

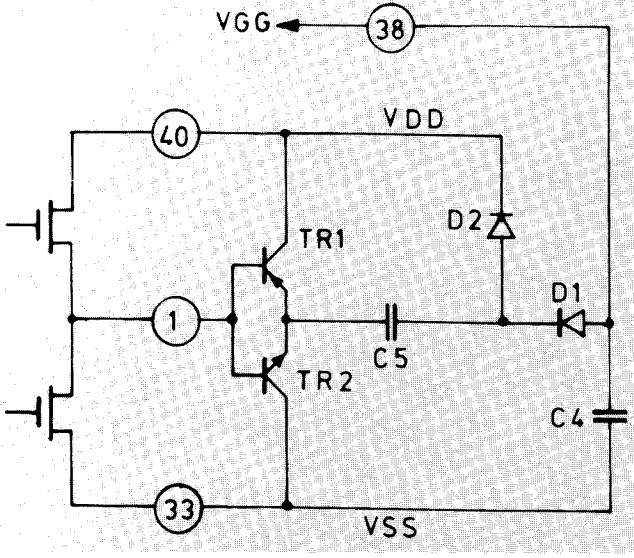


D1/D2 1N4148 or similar.

C4 ≥ 0.22MFD 10%
C5 ≥ 0.01MFD 10%

Pump ensures adequate supply volts for high speed circuits at minimum VDD.

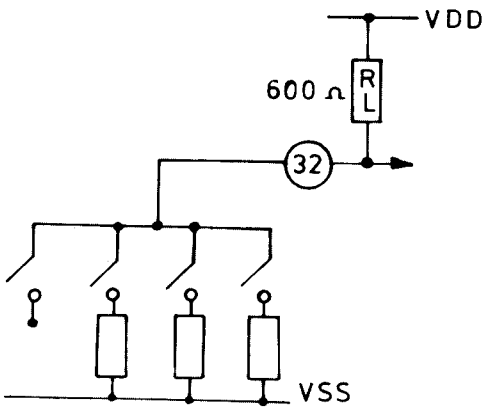
Note: Do not load VGG externally



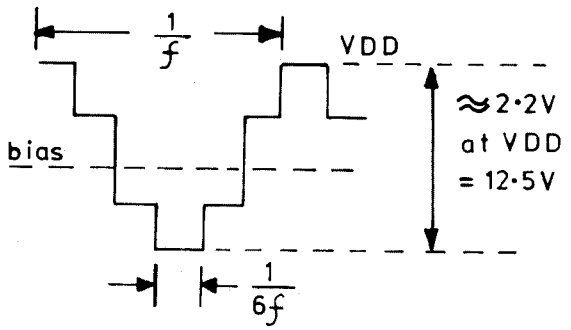
Alternative pump circuit ensures operation if VDD drops to approximately 9V.

TR1 – 2N3906 or similar
TR2 – 2N3904 or similar

TX OUTPUT



OUTPUT WAVEFORM



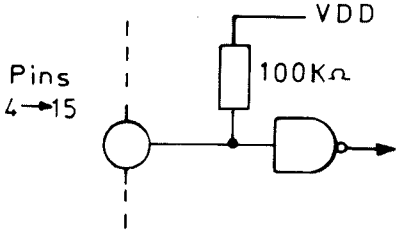
Note: Output goes to bias level during TX delay

CODE PROGRAMMING

INTERNAL PIN CIRCUITS

DIGIT SELECT INPUTS

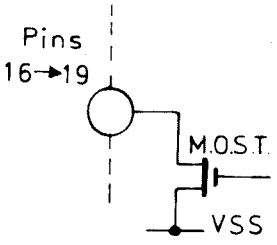
(Tones 0 thro' 9, R.G.)



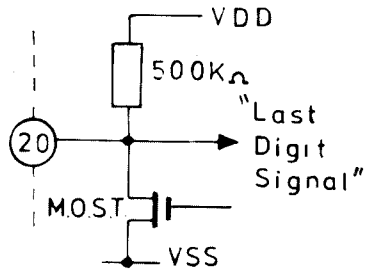
(Select = Logic '0' ≤ −3·0V)

DIGIT SEQUENCE SWITCHES

(S1 thro' S4)



(S5)



(MOST Switches: R'on ≈ 3KΩ)

EXAMPLES OF CODING LINKS

CODE →	2 0 9 6 4	2 1 1 1 0	1 5 6 9 6	3 6 5
S1—S5 →	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
DIGITS→	2 0 9 6 4	2 1 R 0	1 5 6 9	3 6 5
Note →		(1)	(2)	(3)

Notes

(1) For consecutive repeat digits use repeat (R) tone, e.g. 39999 is coded 39R9R.

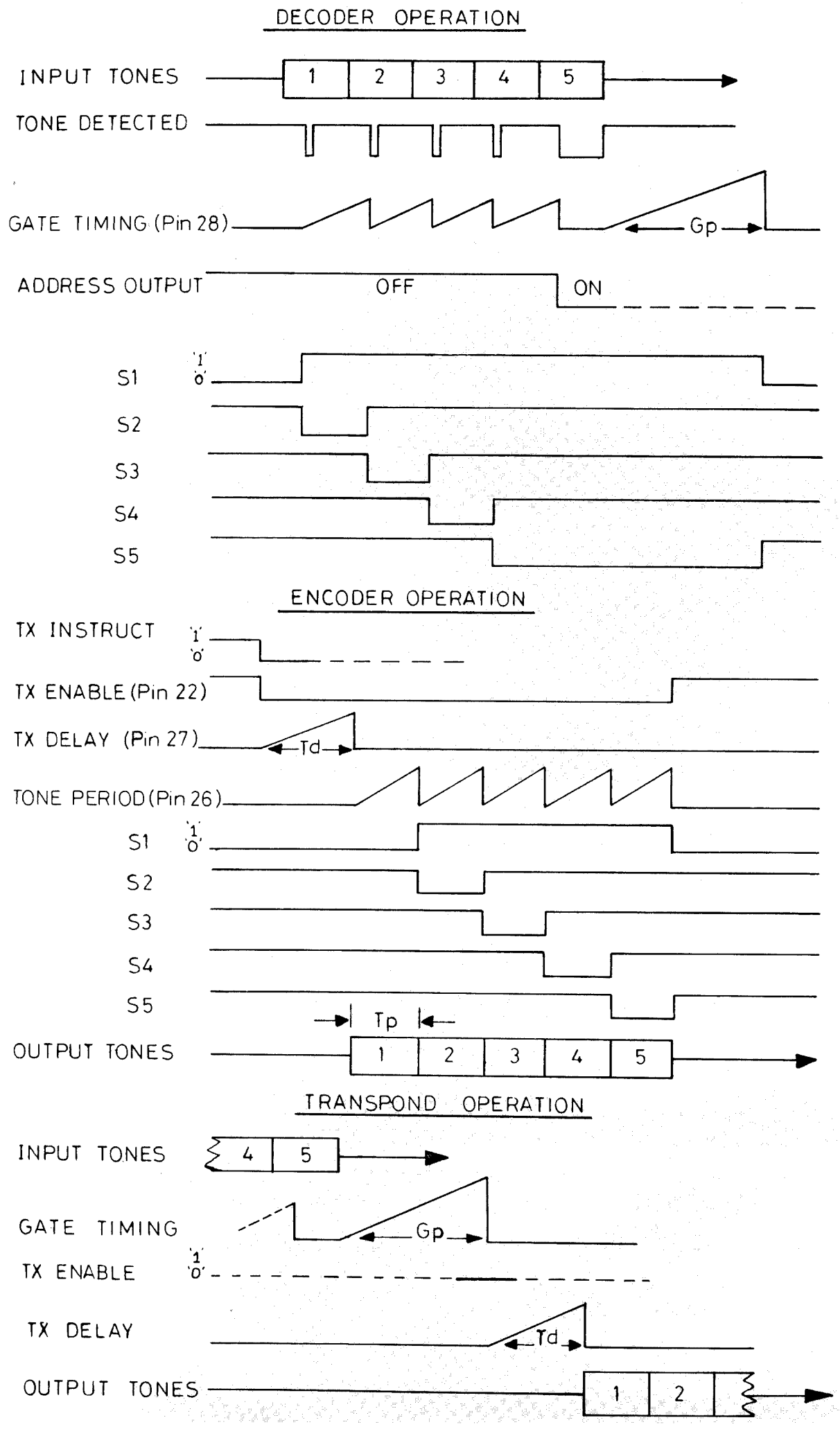
(2) If S5 digit common to other code digit, use diode in S5 link. 'Last digit' armed when S5 is at '0' level, therefore direct link shortens code.

(3) For intended short codes, link S5 direct to last digit. For 2 tone, link S5 to S2; 3 tone, S5 to S3; 4 tone, S5 to S4. Unused switches left disconnected.

(4) Long external links are permitted without affecting frequency calibration, but limit external pin capacity to 5,000pfd max to avoid tone select delays.

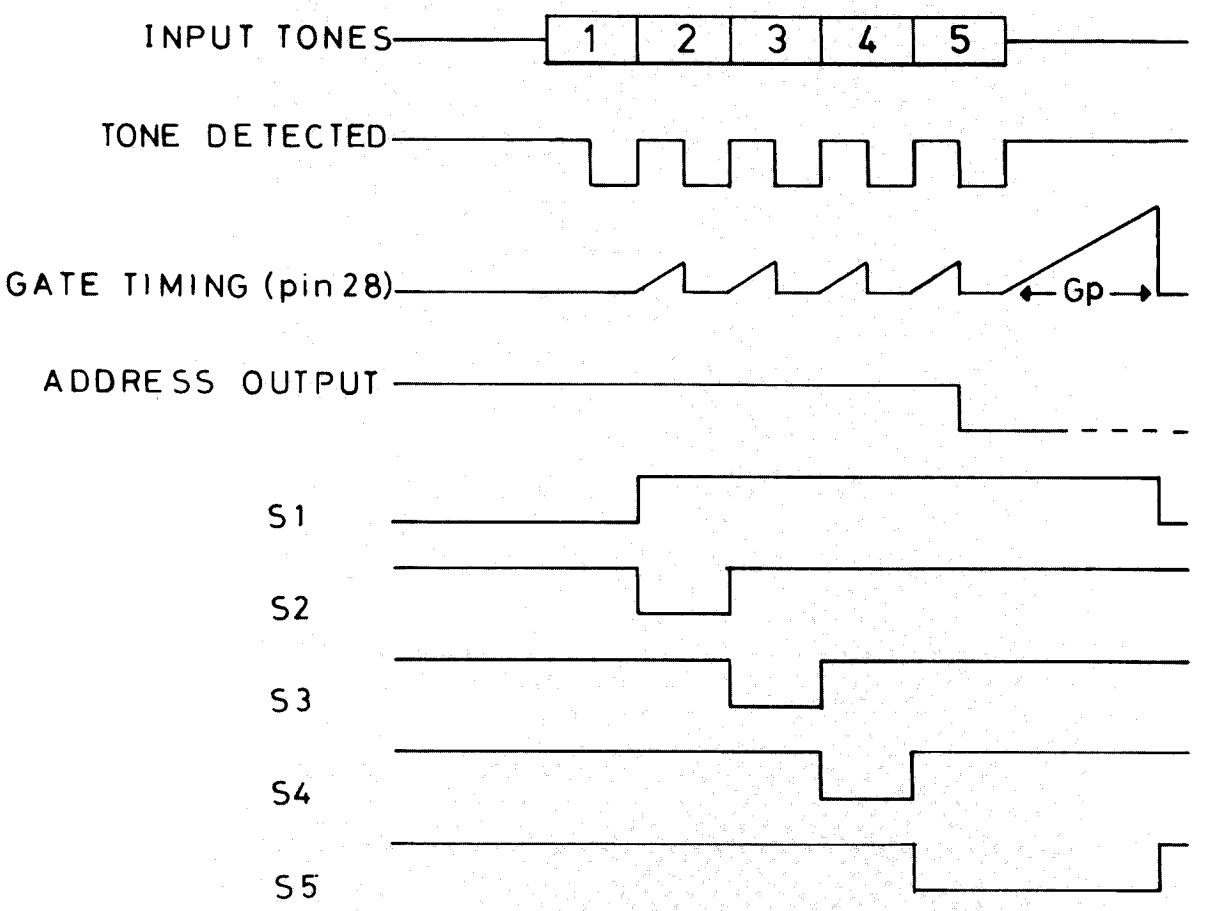
(5) Selecting two or more digits simultaneously may give incorrect frequency.

CODE FORMAT & TIMING 'A' & 'N' VERSIONS (Logic '1' = near VDD. Logic '0' = near VSS)

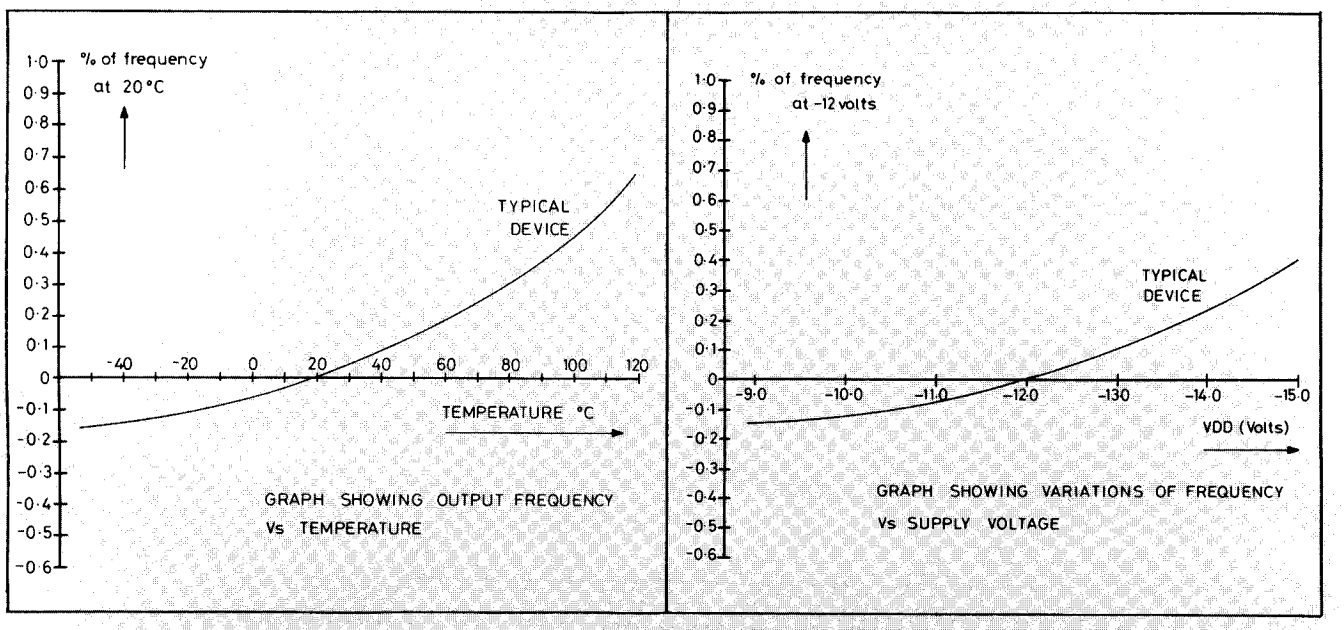


CODE FORMAT & TIMING 'S' VERSION (Logic 1 = near VDD Logic 0 = near VSS)

DECODER OPERATION

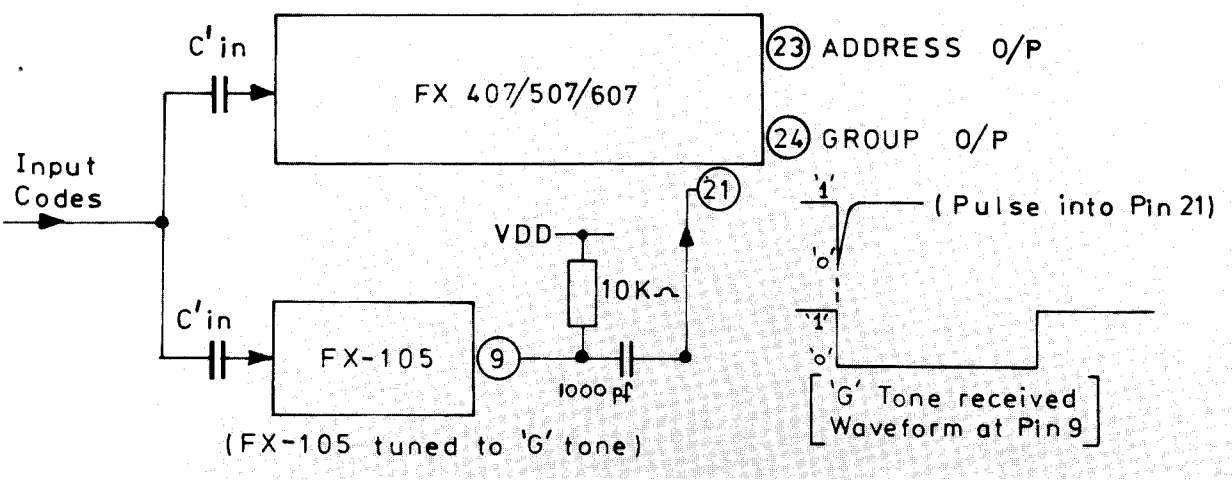


STABILITY CHARACTERISTICS



GROUP CALLING

CIRCUIT ARRANGEMENT



When an input code contains a 'G' tone, the FX-105 switches ON and the 1→0 edge is coupled to the Group Initiate input (pin 21) of the 407/507/607. This causes the 407/507/607 to change from the Address code programmed, to an internal Group programme for the remaining digits of the input code. If the Group code is correctly completed, the Group output of the 407/507/607 switches ON. The Group Initiate input is effective only if the correct first two digits of the Address code have been received. The Group Initiate input is disabled during transmit mode, a Group call is transmitted by encoding the 'G' tone via the Digit Select inputs.

EXAMPLES OF GROUP CALLING

INPUT CODE	ACTIVATES RECEIVERS CODED:	GROUPS OF:	O/P SWITCHED
25784	25784 only	1	ADDRESS
2578G	25780 ⟶ 25789	10	GROUP
257GR	25700 ⟶ 25799	100	GROUP
25GRG	25000 ⟶ 25999	1,000	GROUP

CALIBRATION PROCEDURE

Conditions: VDD = 12.5V, T'AMB = 20+/−5°C, no input signals.

(1) Programme code 6XXXX (FX-407), or 5XXXX (FX-507/607), where 'X' is any convenient digit.

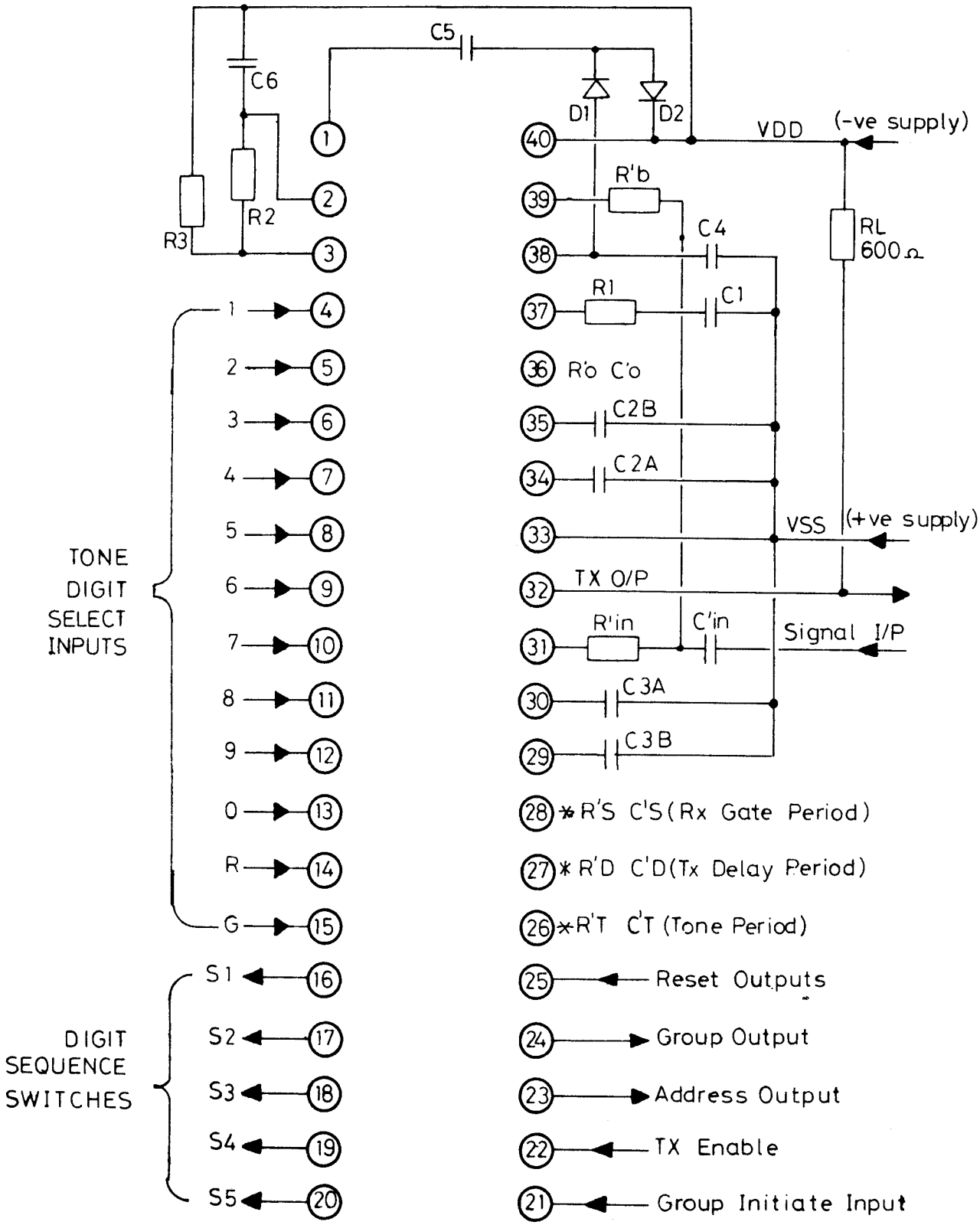
(2) Apply VDD. Wait several seconds, then connect shorting link across CT.

(3) Press TX Enable button and read frequency at TX output. Signal is a continuous tone.

(4) Adjust R'0 until frequency is exactly 1541Hz (FX-407), 1530Hz (FX-507), or 941Hz (FX-607).

(5) Remove CT shorting link. Calibration completed for all channels, RX and TX.

EXTERNAL COMPONENT CONNECTIONS



*See code timing components

SPECIFICATION

Max. ratings. *Failure to observe may result in device damage*

Max. voltage between any pin and $+V_e$ supply. (Pin 33) .. .. −20v & +0.3v

Operating temperature range .. .. −30° C to +85° C

Storage temperature range .. .. −55° C to +125° C

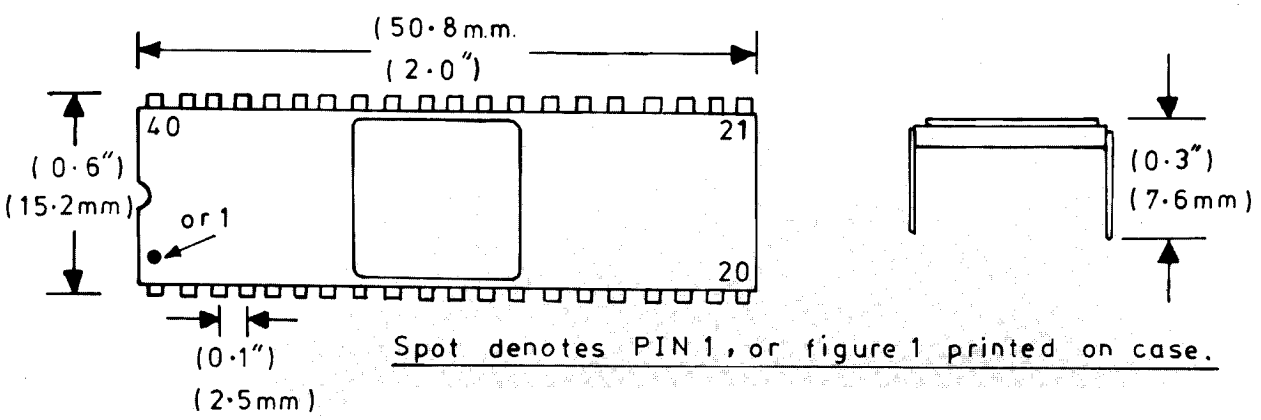
Device dissipation. (at 20°C ambient temperature) 400mW

Characteristics

NOTE: Due to AC signal coupling either supply polarity may be 'ground'.

Symbol	Parameter	Notes		Min	Typ	Max	Units
V_S	Supply voltage	Operating range		10	12	15	V
I_S	Supply current	Total, excluding external loads			12		mA
	Signal input	Tone amplitude range		0.05		1.0	V.(r.m.s.)
		Signal + noise amplitude				2.0	V.(r.m.s.)
$\frac{S}{N}$	Signal to noise ration. Noise BW = 3kHz	Operating S/N for specified code timing (in receive mode).			−6		dB
		Use longer tones and increase R'in. C3			−18		dB
BW (407A/S)	Bandwidth 0dB i/p	100% decode		3			%
	Bandwidth +24dB i/p	0% decode				6	%
BW (507A/S)	Bandwidth 0dB i/p	100% decode		4			%
	Bandwidth +24 dB i/p	0% decode				9	%
BW (607N)	Bandwidth 0dB i/p	100% decode		4			%
	Bandwidth +24dB i/p	0% decode				9	%
	Frequency stability	In transmit & receive	vs supply		0.05		%/%
			vs T'amb.		0.005	0.015	%/°C

PACKAGE DETAILS (Not to scale)



Spot denotes PIN 1, or figure 1 printed on case.

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