

SELECTIVE SIGNALLING DEVICES '07 SERIES

GENERAL DESCRIPTION

The FX-107, FX-207 and FX-307 are a powerful and flexible family of high performance monolithic signalling devices, based on 3-tone Sequential Code signalling techniques. Constructed using MOS/LSI technology, the devices perform all frequency discrimination, tone generation and code timing functions on-chip, using simple external CR networks.

The family members are FX-107, a single code transceiver with transponder capability; FX-207, a multi-code transmitter with logic controlled selection of any one-from-eight codes; and FX-307, a multi-code Receiver which decodes 8 different input codes and provides an appropriate binary coded output.

Transmitter devices generate the programmed Group Code on receipt of a logic instruction; Receivers decode Group Codes applied to their signal input and operate integral output switches when the programmed code/s are received.

Used separately, or in any required combination, these exciting new devices combine high performance with economy and simplicity of use; they offer a new state of the art approach to applications involving selective signalling between two or more points, using a common transmission line or radio link.

Virtually any number of outstations can be hooked into the common line and a variety of instructions signalled to each one selectively. Automatic answer-back, automatic station scanning and station status check functions are very easily implemented, and cost barriers previously associated with complex functions of this type are dramatically reduced.

Extensive applications exist for the '07 series in Telecommunications, Control Signalling, Instrumentation, Automation, Process Control and similar fields. Typical examples include selective control switching, remote alarm signalling, data transmission, selective telemetry, status transponding, selective paging, intercom systems, vehicle paging and identification, security systems and numerous similar areas.

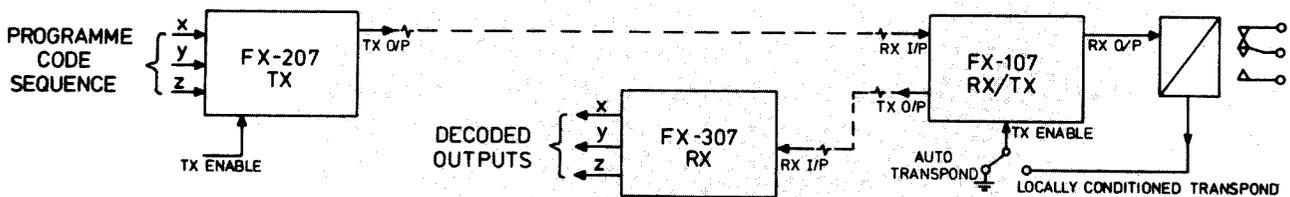
Designed for maximum compatibility, the devices employ identical frequency discrimination and code timing circuits and operate on a standard 3-Tone Sequential Code principle. Each code consists of three tones, each of different consecutive frequency and sent in a pre-determined sequence (Group Code).

The operating frequencies and channel bandwidth capabilities of the '07 family are such that upwards of hundreds of thousands of unique Group Codes are available to the user. Another particularly important feature is the extreme simplicity of setting-up and calibrating the code frequencies.

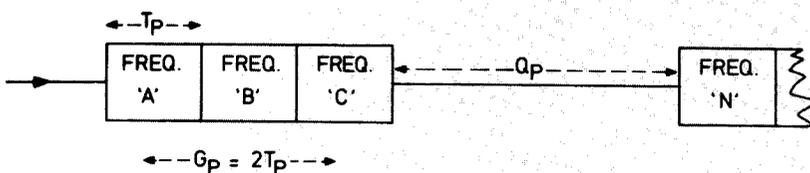
All devices are housed in 16 lead ceramic dual-in-line packages and operate from a single wide tolerance D.C. Supply.



THE '07 SERIES OF SELECTIVE SIGNALLING DEVICES



THE 3-TONE CODE PRINCIPLE



T_p = TONE PERIOD

G_p = GATE PERIOD

Q_p = QUIESCENT PERIOD

FIG.1

THE 3-TONE GROUP CODE

A Group Code consists of a series of three tones, the frequencies used and their order of transmission determines the code value.

The Group Code system employed for the '07 family operates according to the following rules;

1. All three tones in a Group Code are of equal nominal duration (T_p), which must be sufficient to allow recognition by a receiver.
2. Consecutive tones in each Group Code *must* be of different frequency; alternate tones may, however, be repeated.

Example: Frequencies A,B,C and A,B,A are legal codes; A,A,B and A,B,B, are illegal codes.

3. A receiver will recognise a correctly addressed code *only* if consecutive tones in the group are received within a specified gate period (receiver Gate Period G_p).
4. A minimum time interval (Quiescent Period Q_p) must elapse between transmission of consecutive Group Codes, in order to avoid "alias codes", e.g. false codes based on the 'run-on' tone sequences present in two consecutive Group Codes.

NOTE: *Simultaneous* transmission of different Codes over a common transmission line will *inhibit* decoding at the receivers being addressed. (See Special Note on Receivers.)

The number of unique Group Codes obtainable in a system depends on the number of tone frequencies used. For codes based on non-repeat tones (all three tones are different frequencies) the number of codes possible is $(N \times N-1 \times N-2)$, where N is the total number of tones available. By including legal repeat tones the number of codes rises to $(N \times N-1 \times N-1)$.

By way of example, if 10 tones are available in a system, the number of different Group Codes are $10 \times 9 \times 8 = 720$; using legal repeat tones this rises to $(10 \times 9 \times 9) = 810$ codes. The channel selectivity of the '07 devices is such that over 40 tone channels are easily obtainable in the 200HZ to 3KHZ audio transmission range, yielding upwards of 60,000 codes.

GROUP CODE TIMING

TX TONE PERIOD (T_p)

To ensure correct recognition by a receiver, transmitter devices (107/207) *must* send a minimum of ten cycles of each tone in the Group Code. This is an absolute design limit and assumes accurate period timing; to allow for component and other tolerances, the recommended minimum is twelve cycles of each tone. In a multi-station system it is usually convenient if all stations have common values for timing components; in this case, the *lowest* tone frequency used in the system should be adopted as the basis for all timing calculations. Apart from this any preferred tone length may be used. A transmitter tone period is controlled by a single CR network (R_t & C_t of Figs 6 & 7); this determines the period of an internal timing stage. Note that T_p is the transmission period for *one tone*; the overall time for transmission of a Group Code is therefore $3T_p$, there being no interval between successive tone steps.

FORMULA. $T_p = 0.63 R_t C_t$ & $R_t C_t = \frac{T_p}{0.63}$

Where 0.63 is a design constant and subject to production tolerances of 0.6 to 0.7; R = Meg-Ohms, C = MFD, T_p = seconds. Recommended minimum component values: R = 100k Ω C = 0.001 MFD.

RX GATE PERIOD (G_p)

The tone sequence decoding circuits of the 107/307 receivers include a timing gate. This gate period is triggered (or re-triggered) as each programmed tone is received and sets the *maximum* time allowed for receipt of the *next consecutive* tone in the Group Code. If one (or two) tones in the group have been detected, but the second (or third) tone is not received within this gate period, the decode system clears down and reverts to first tone search again (FX-107) or adopts an "idling" position (FX-307).

This gate period is controlled by a single CR network (R_s & C_s of Figs 6 & 10) which determines the period of an internal retriggerable monostable stage. G_p should always be slightly longer than T_p , and to allow for component tolerances throughout the system should be calculated to equal $2T_p$, but longer periods may be used if preferred.

FORMULA: $G_p = 0.63 R_s C_s$ & $R_s C_s = \frac{G_p}{0.63}$

Where 0.63 is a design constant and subject to production tolerances of 0.6 to 0.7; R = Meg-ohms, C = MFD, G_p = seconds. Recommended minimum component values: R = 100k Ω C = 0.001 MFD.

QUIESCENT PERIOD (Q_p)

The interval between the last tone of one Group Code and the first tone of the next should not be less than period Q_p ; this ensures that all receiver tone gates have cleared down when the new code transmission commences and avoids alias code switching.

To allow for G_p (Gate Period) component tolerances, particularly with multistation systems, the general basis $Q_p \geq 1.5G_p$ is recommended.

The rules for Q_p may be modified for special applications, e.g. "all stations call" and "station size" arrangements, or where consecutive Group Codes employ completely different frequencies. Where the FX-207 (multi-code transmitter) is employed in an automatic scanning system, using the cyclic mode of operation, the Q_p or T_d period is determined by a single CR network (R_d & C_d of Fig 7). This controls the period of an internal monostable (T_x Delay); (see also notes on FX-207).

FORMULA: Q_p or $T_d = 0.7 R_d C_d$ & $R_d C_d = \frac{Q_p \text{ or } T_d}{0.7}$

Where 0.7 is a design constant and subject to production tolerances of 0.65 to 0.75; R = Meg-ohms, C = MFD, Q_p or T_d = seconds. Recommended minimum component values R = 100k Ω , C = 0.001 MFD.

SPECIAL NOTE ON RECEIVERS

The tone recognition system employed by the FX-107/307 receivers is based on a period sampling technique. Input signals are amplified and shaped to provide clock signals to the bistable flip-flop, the output of which is a square wave having a period equal to the interval between successive input wave-form 'zero-crossings' (see Figs 6 & 10).

The flip-flop output triggers a dual monostable, which generates reference periods corresponding to $\frac{1}{f'_a}$ and $\frac{1}{f'_b}$, where f'_a and f'_b

represent the tone accept channel edges, i.e. Bandwidth. These periods are determined by $R_A/R_B/R_C$, C_1 & C_2 and the D.C. reference levels applied to the monostables via $R_{k1,2,3}$. The reference periods are compared against the signal input period in a comparator, the output of which controls a special counter/storage system. This counting system discriminates against random spurious information and delivers an output only when a true inband tone signal is received. Gating circuits are incorporated which prevent false operation when harmonics of the tone frequency are applied. This tone recognition system yields extremely sharp tone channel definition, coupled with a fast response time and high immunity to false turn-on due to outband noise; regardless of the noise frequency and amplitude. The period sampling system requires, however, a 'regular' input waveform for correct operation. Input noise can, if mixed with the required inband tone, prevent the circuit from recognising that the tone is present. This effect is produced because the noise 'jitters' the interval between successive signal zero-crossings and the comparator/counter rejects the information as not being consistent with an input signal having a frequency actively within the tone channel limits.

If the noise is random in nature, e.g. spurious noise spikes, or short term interference, it will have little effect other than possibly to increase the overall tone recognition time by a few cycles. If the noise is *continuous*, e.g. parallel inband and outband tones are on the signal line simultaneously, the device will not recognise the inband tone. If the noise is semi-continuous, e.g. speech signals, increasing the inband tone duration will allow the tone to be recognised during a momentary 'noise' pause.

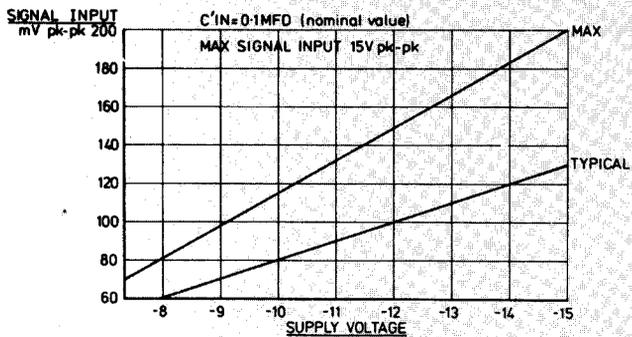
The device is therefore ideal for use when inband tones (Group Codes) are transmitted sequentially, but operation in parallel-tone signalling schemes is not recommended, unless adequate pre-filtering is used.

SIGNAL INPUT NOTES

All the devices incorporate a signal input amplifier offering a high input impedance. The amplifier is designed using negative feedback principles and therefore the input is D.C. self-biased. Signals to the input pin should normally be A.C. coupled to avoid disturbing this bias point. High level pulse signals ($\geq -6V$) may be directly coupled. The actual shape of the signal waveform is not important and may be sine, square or pulse in form.

Input impedance is typically 50k Ω at mid-range supply voltages. This value varies with supply voltage and production tolerances, and a total spread of 25k Ω to 200k Ω should be assumed. Fig. 2 shows the production spread of input sensitivity versus supply voltage.

FIG.2 SIGNAL SENSITIVITY versus SUPPLY VOLTAGE



TX TONE & RX CHANNEL FREQUENCIES

Fig. 3 illustrates 3 typical tone channels. Provided adjacent channels do not overlap, they may be spaced as required. A tone frequency (f_c) falling between the channel edges ($f'a-f'b$) is recognised as an 'inband' tone.

Tone/channel frequencies are determined by resistors RA/B/C and capacitors C1/C2. (See Fig. 4.)

Any *one* resistor, together with *both* capacitors, determines the frequency of the lower edge ($f'b$) of a receiver channel or, in the case of FX-207, the frequency of one tone. Commutator switches select each resistor in a programmed sequence, thus forming the Group Code.

The commutators have a low 'on' resistance, typically 300Ω , and errors between frequency steps depend principally on the *ratio* tolerances between RA-RB-RC. If required, these can be minimised by including a common ballast resistor RZ; ratio errors are then reduced by a factor $\frac{RZ}{RZ + RN}$, where RN is the incremental resistance of the highest value path. All resistor calculations are based on *total* path resistance, including any value RZ.

Capacitors C1/C2 are switched alternately during Tx operation (parallel connected for Rx operation) and differences in value may unbalance the Tx output waveform. More important, unbalanced values may cause the FX-107 Tx-mode tones to deviate from the centre of the corresponding Rx-mode channels; this may cause difficulties in narrow channel transponder applications. Observe the recommended tolerances.

Note that two capacitors, connected to a common pin, are specified for receiver FX-307; this assists in system component standardisation (2X values are not preferred listing) and allows channel frequencies to be coded simply by standard resistor values, regardless of device type. RA/B/C and C1/C2 should all be high stability components, metal oxide resistors and polystyrene or good grade polycarbonate capacitors are suggested.

TX TONES/RX CHANNELS FIG.3

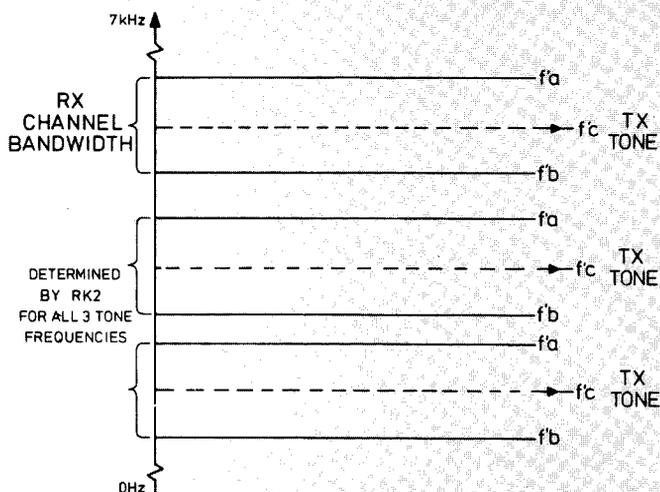
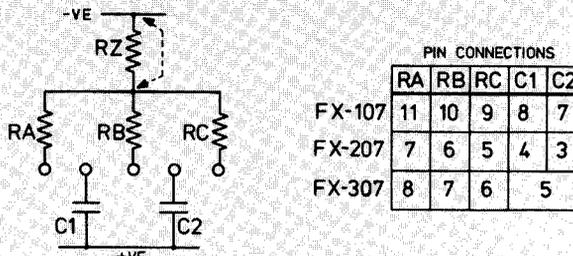


FIG.4 TONE/CHANNEL FREQUENCY COMPONENTS



PIN CONNECTIONS

	RA	RB	RC	C1	C2
FX-107	11	10	9	8	7
FX-207	7	6	5	4	3
FX-307	8	7	6	5	

FX-107/307 RECEIVER CHANNEL

$$f'b = \frac{1}{0.7 R (C1+C2)} \text{ Hz}$$

$$f'a = f'b \left[1 + \frac{BW}{100} \right] \text{ Hz}$$

i.e BW(%) above $f'b$

FX-207 TX. TONE $\rightarrow f_c = \frac{1}{0.7 R (C1+C2)} \text{ Hz}$

FX-107 TX. TONE $\rightarrow f_c = f'b \left[1 + \frac{BW}{200} \right] \text{ Hz}$

i.e Mid-way between $f'a$ & $f'b$

COMPONENT LIMITS (no maximum values specified)

RA, RB, RC = $100K\Omega$ min
2% tolerance max

C1 & C2 = 0.001MFD min
5% tolerance max

CHANNEL BANDWIDTH

The bandwidth (BW) of a receiver tone channel is the difference in channel edge frequencies $f'a$ and $f'b$, expressed as a percentage of $f'b$. BW is independent of operating frequency and is determined simply by the ratio of RK1 and RK2 in fig. 5. These resistors form a potential divider applying reference levels to the specified pins.

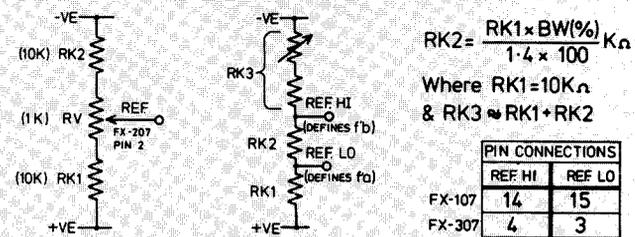
The *difference* in the two levels determines BW; the *absolute* level, as a fraction of the supply, controls a constant 'K' used in frequency calculations. When REF. H1. = 50% of supply, $K = 0.7$ (as given in the formulae for fig. 4), subject to a production tolerance of ± 5 nominal.

RK3 may be used to adjust factor K and offset tolerances in components R, C1 & C2, thus calibrating one tone channel. Frequency accuracy of the remaining two channels is then subject basically to tolerances of the remaining channel resistors. With transmitter FX-207, no BW applies and only one reference level is used (see fig. 5), and adjustment of K is effected via RV.

Maximum adjustment limits for reference levels are 45% to 55% of supply voltage, yielding K values of 0.6 to 0.8. Resistors used for potential divider should be high stability types and the value of RV just sufficient to provide the required adjustment range. Convenient values for 107/307 would be $RK3 = 8.2K\Omega$ fixed resistor plus $4.7K\Omega$ RV.

Unless high channel density is mandatory, a BW value providing good margins for system tolerances should be adopted; these include temperature/supply variations, RA/B/C tolerances and to a less extent, BW component tolerances. Values of 5% to 8% are suggested for general use; these can yield high code numbers (up to 14 channels/octave) with good system operating tolerances.

FX-207 TONE TRIM **FX-107/307 BANDWIDTH COMPONENTS**



$$RK2 = \frac{RK1 \times BW(\%)}{1.4 \times 100} K\Omega$$

Where $RK1 = 10K\Omega$
& $RK3 \approx RK1 + RK2$

PIN CONNECTIONS

	REF HI	REF LO
FX-107	14	15
FX-307	4	3

RK2 versus BANDWIDTH (where $RK1 = 10K, RK3 = 8.2K$ & $RV = 4.7K$)

BANDWIDTH	4.5%	5.0%	6.0%	9.5%
RK2	330Ω	360Ω	430Ω	680Ω

FIG.5

FIG. 8 FX-207 TRUTH TABLES

TX ENABLE	ENABLE CONTROL	TX OUTPUT
1 → 0	0	1 GROUP CODE
1	1	NO TX
1 → 0	1	CYCLIC
1	0	NO TX

ENCODING

INPUTS			OUTPUT		
X	Y	Z	CODE SEQUENCE		
0	0	0	A	B	A
0	0	1	C	B	A
0	1	0	C	A	B
0	1	1	B	C	A
1	0	0	B	C	B
1	0	1	A	C	B
1	1	0	B	A	C
1	1	1	A	B	C

FIG. 9 FX-307 TRUTH TABLES

CONTROL		MODE OF OPERATION
1	2	
1	1	UPDATE CONTINUOUSLY
0	0	RESET (X,Y,Z = 1,1,1)
0	1	LATCH AS DISPLAYED
1	0	LATCH TO NEXT CODE

DECODING

INPUT			OUTPUTS		
CODE SEQUENCE			X	Y	Z
A	B	A	0	0	0
C	B	A	0	0	1
C	A	B	0	1	0
B	C	A	0	1	1
B	C	B	1	0	0
A	C	B	1	0	1
B	A	C	1	1	0
A	B	C	1	1	1

GENERAL INFORMATION FX-307

The FX-307 is a multi-code Receiver programmed to decode any one from eight different input Group Codes, all based on sequential permutations of the three programmed frequencies. The three code frequencies are determined by resistors RA, RB and RC connected to pins 8, 7 & 6.

Receipt of a programmed code appears at the X, Y, Z logic outputs as a 3-line binary number, the decoding truth table is shown in fig. 9. Note that the encoding/decoding truth tables for 207 and 307 are identical.

Following receipt of a code the appropriate data is maintained at the X, Y, Z outputs until a different code is received, or until reset by a Reset logic input. No change takes place at X, Y, Z if the displayed code is repeated. For every programmed Group Code received, including repetitive codes and irrespective of the status of the Control Inputs, a pulse appears at the Code Received Output. This pulse is a '0' level maintained for approximately two cycles of the third code tone ($t = \frac{2}{f}$), the trailing edge occurring

simultaneously with any updating of the X, Y, Z outputs. The pulse may be used for strobe or display clocking purposes, and as a monitor that programmed codes are being received, even where these do not cause updating of the X, Y, Z outputs.

The two Control Mode Inputs, pins 13 & 14, provide for a choice of operating modes, as shown in fig. 9. Instructions to these inputs are direct-acting, i.e. they are not conditional on the status of the internal tone decoding circuits. In "Updating Continuously" the X, Y, Z outputs reflect continually the value of the last Group Code received. "Latch to Next" causes the X, Y, Z outputs to latch when the next input code is received, even if this is a repeat of the code displayed. "Latch as Displayed" gives immediate latching of the existing X, Y, Z output state and "Reset" switches the

outputs to the state shown in fig. 9. A signal input amplifier is also incorporated in the circuit. (See signal input notes.)

The FX-307 is so designed that the Reset state should appear at the X, Y, Z outputs when power is first applied. If a guaranteed start-up reset state is required small capacitors should be fitted between the Control Mode inputs (1 & 2) and ground.

The tone decoding system used in the FX-307 (and in the FX-107 Rx/section) will also accept input codes where each tone step is separated by an interval between successive tones, provided the Gating Period (Gp) is calculated to include these intervals. This only applies where Group Codes are transmitted from sources other than the FX-207 or FX-107 TX/section.

SIMPLIFIED BLOCK DIAGRAM FX-307 SHOWING EXTERNAL COMPONENTS REQUIRED FOR OPERATION

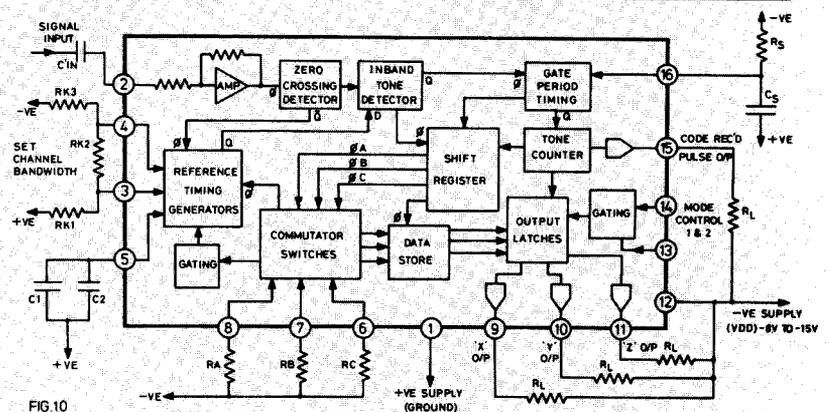


FIG. 10

SELECTIVE SUB-STATION CALLING, WITH CALL ACKNOWLEDGE

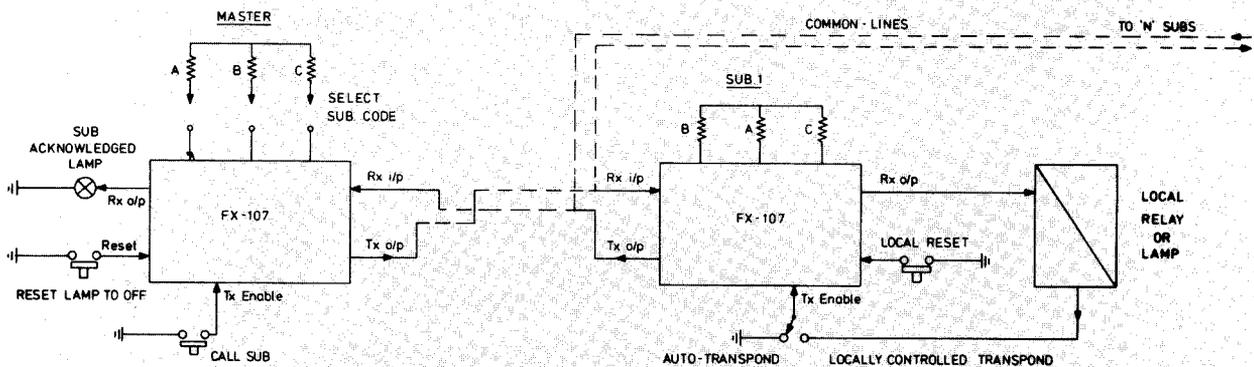


FIG. 11

Fig. 11 shows a simple master/sub-station calling system employing FX-107's. Sub-station address codes are selected by switching RA/B/C at the master; receipt of an address code operates a local sub-station switch function.

Sub-station 107's are connected for auto-transpond and re-transmit their address code each time it is received; this operates the acknowledge lamp at the master, which is ready-coded for the reply. The sub transpond action can be locally gated, if required, to verify that the local function has switched satisfactorily.

Master and sub may be reset to OFF locally or the master can

re-transmit the address, switching off the sub local circuit and (by separate action) the master acknowledge lamp.

Separate lines are used for call and reply, due to the short transpond delay of a 107 (transpond $Q_p = G_p$). With a single line other sub-stations may respond to an alias code formed by an address followed by a transponded reply. If a transpond is locally delayed ($Q_p = 1.5 G_p$) or the same first tone used for all stations, one common line may be used for address and reply codes.

Note: Signals are applied between the transmission lines and a common ground line.

MULTI-CODE SIGNALLING BETWEEN TWO POINTS

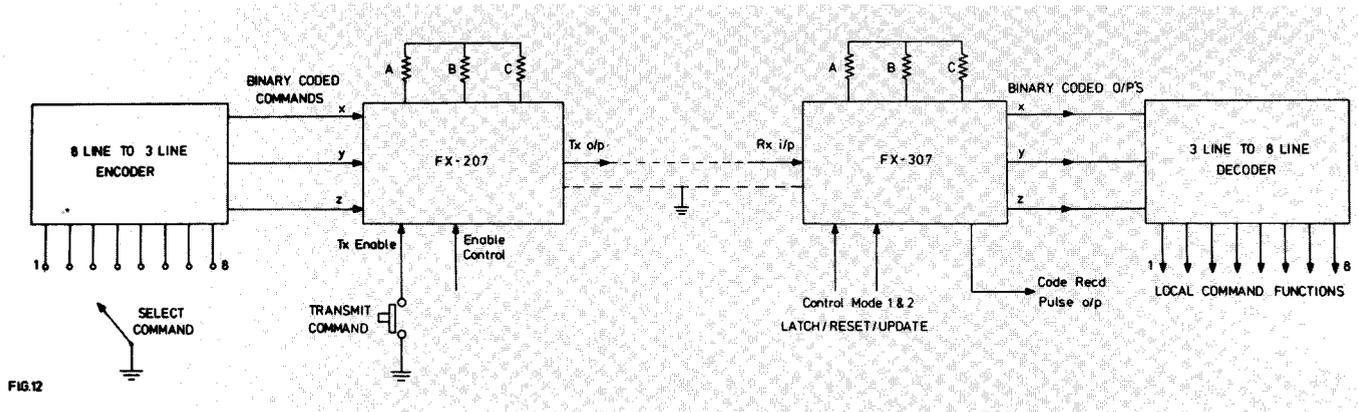


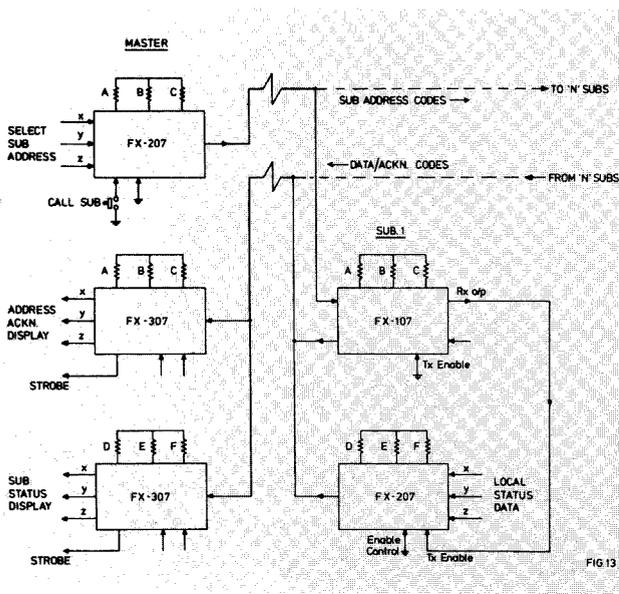
Fig. 12 shows how a FX-207 and a FX-307 can be used to transmit several coded instructions to a remote point, using one common line.

The required command code is entered at the X, Y, Z inputs of the 207, either directly or via the octal/binary encoder illustrated, and transmitted by grounding the TX Enable input.

If the Enable Control is at '0' level, one Group Code is sent for each TX Enable command. With TX Enable at '0' and Enable Control at '1' continuous code transmissions take place, representing the current data at the X, Y, Z inputs.

Group Codes received by the remote FX-307 appear as decoded logic levels at the X, Y, Z outputs and operate appropriate local functions through the binary/octal decoder. The Code Received Output pulse may be used for strobing purposes; latching and other functions may be selected using the Control Mode inputs. The 207 encoder can be a simple diode matrix; a suitable 307 output decoder is a SN 74145 with MOS/TTL interface buffers in the X, Y, Z lines.

SELECTIVE CALLING WITH ACKNOWLEDGE + STATUS TRANSPONDING



Sophisticated signalling functions are easily implemented using '07 series devices. Fig. 13 outlines a system where remote sub-stations are selectively addressed, receipt of an address verified and the sub-station status displayed.

Sub-station 107's act as address decoders and transmit an acknowledgement when called. The 107 simultaneously instructs the substation 207 to transmit the current status (alarm conditions, data etc), the 207 TX Delay period allowing sufficient time for the acknowledge code to be cleared before data is sent.

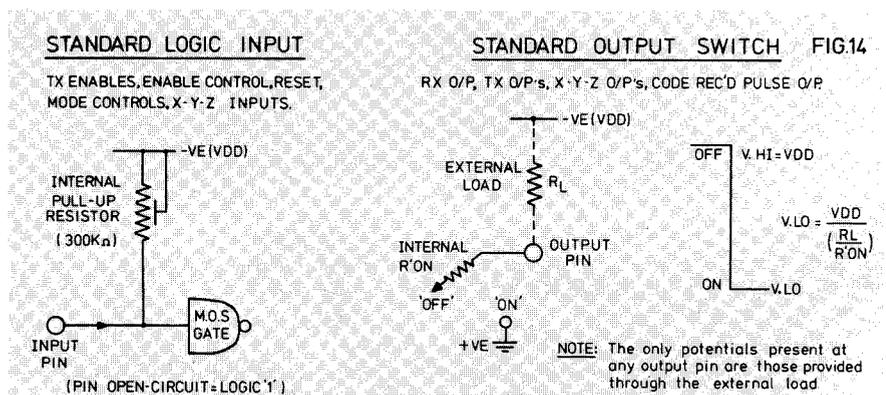
ABC channels are used for address codes and DEF channels for data, this allows up to 8 substations to be called and the status of each verified (any 1 of 8 values). The number of outstations and status data codes can be expanded as required. Automatic station scanning can also be obtained by arranging for the Address Acknowledge display to encode the 207 Address transmitter (next address forward); the 207 may then transmit repetitively (cyclic mode) or in response to a clock from the 307 Code Received strobe output.

INTERFACE NOTES

Fig. 14 shows the equivalent circuit for an uncommitted MOS output switch employed on all the '07 series. Interfacing to TTL may be achieved by a suitable choice of RL to provide to the correct TTL input levels for the supplies used. Logic inversion may be obtained by using a buffer transistor (NPN) between the MOS output and the TTL input.

i.e. With RL only, output ON = TTL logic '0'
With transistor buffer output ON = TTL logic '1'.

Each control input (TX Enable, Enable Control, Rx Reset, Control Mode 1 & 2, X, Y, Z data inputs) has a 300KΩ internal pull-up resistor which gives input = '1' when pin O/C.



SPECIFICATION

MAXIMUM RATINGS'

Applicable to all devices unless stated

Max. Voltage between any pin and +ve supply pin	-20v & +0.3v
Max. Output Switch Load Current	-5mA
Max. device dissipation @ 20°C T'amb	400mw
Operating temperature range	-30°C to +85°C
Storage temperature range	-55°C to +125°C



CHARACTERISTICS

(Supply voltage - 12v ± 2v, T'amb = 20°C, operating frequencies 200 HZ to 3KHZ unless specified)

Symb.	Parameter	Conditions & Notes	Min	Typ.	Max	Units
VDD	SUPPLY VOLTAGE	Operating limits	-8	-12	-15	V
IDD	SUPPLY CURRENT	Total, excluding output load current	FX107/307		6	mA
			FX-207		3	
	OPERATING FREQUENCIES	Recommended operating limits, Tx Tone/Rx Channel frequencies	0.1		7	KHZ
BW	CHANNEL BANDWIDTH	Recommended limits	FX-107/307		2	10 %
Δf	FREQUENCY STABILITY	Tx/Rx Frequency stability vs Supply Volts & T'amb. Ext. component co-efficient excluded.	SUPPLY	0.04		%/%
			T'AMB	0.01		%/°C
Vin	SIGNAL AMPLITUDE RANGE	Sine or pulse input signals, A.C. coupled. Input impedance typically 50 KΩ.	FX-107/307		0.1	15 V pk-pk
R'on	OUTPUT 'ON' RESISTANCE	Tx,Rx,X,Y,Z & Code Rec'd Outputs. Internal resistance between O/P pin & ground with switch 'ON' ('OFF' resistance > 10MΩ)		0.3	1	KΩ
'1'	LOGIC HIGH	Logic levels to all control inputs (Internal 300KΩ pull-up resistors give logic '1' when pin O/C)	'1'	-6	-15	V
'0'	LOGIC LOW		'0'	0	-1.5	V

SUPPLY NOTES

Reference to ground, logic '0' and logic '1' in this data sheet are based on the use of a grounded positive supply, i.e. HT (VDD) is negative. A logic '1' level is therefore near VDD (-ve) and a logic '0' level near ground (+ve). There is however, no objection to operation with the -ve supply grounded, but reference to logic polarities remain unchanged; i.e. a logic '1' is *always* -ve with respect to a logic '0'.

Example a) VDD = -12V; +ve = GROUND logic '1' = -12V & logic '0' = 0V
 b) VDD = 0V; ; +ve = +12V logic '1' = 0V & logic '0' = +12V

It is also important to ensure that no pin receives a potential which is positive with respect to the +ve supply pin. Failure to observe this rule may result in damage to the device.

NOTE: Where VDD is below -10V, devices may latch-up if VDD is applied at a slowly increasing rate. To avoid this condition, supplies should rise from zero to VDD in 10mS max.

**COMPONENT EXAMPLES
& CORRESPONDING TIME PERIODS
FOR 6 TONE FREQUENCIES**

R	C1 & C2	Hz
270K Ω	3300pf each	801
220K Ω	"	983
180K Ω	"	1202
150K Ω	"	1443
120K Ω	"	1803
100K Ω	"	2164

MINIMUM PERIODS BASED
ON USE OF 801Hz

R _t	C _t	T _p
270K Ω	0.1MFD	17mS

R _s	C _s	G _p
560K Ω	0.1MFD	35mS

FX-107 PIN DATA		FX-207 PIN DATA		FX-307 PIN DATA		PACKAGE DETAIL	
1. +V SUPPLY	9. RC	1. +VE SUPPLY	9. DATA Z	1. +V SUPPLY	9. O/P X		
2. TX O/P	10. RB	2. REF.	10. DATA Y	2. SIGNAL I/P	10. O/P Y		
3. RX O/P	11. RA	3. C2	11. DATA X	3. REF LO	11. O/P Z		
4. RX O/P RESET	12. -VE SUPPLY	4. C1	12. TX TONE PERIOD	4. REF HI	12. -VE SUPPLY		
5. RX GATE PERIOD	13. TX ENABLE	5. RC	13. TX ENABLE	5. C1 & C2	13. MODE CONTROL 1		
6. TX TONE PERIOD	14. REF HI	6. RB	14. ENABLE CONTROL	6. RC	14. MODE CONTROL 2		
7. C2	15. REF LO	7. RA	15. TX DELAY	7. RB	15. CODE RECD PULSE WP		
8. C1	16. SIGNAL I/P	8. -VE SUPPLY	16. TX O/P	8. RA	16. RX GATE PERIOD		

