

FX-701P

DUAL DATUM FREQUENCY SENSITIVE SWITCH

GENERAL DESCRIPTION

The FX-701P is a monolithic microcircuit housed in a 14 pin plastic D.I.L. package. It functions as a frequency sensitive switch. Monitoring of a frequency input is made very simple by having HI/IN LIMIT/and LO switch output functions.

The device is purpose designed for analogue frequency monitoring applications, such as remote control and tachometry, where switching operations must be performed when a signal frequency reaches pre-determined levels.

This LSI circuit is the basis of a fully operational sub-system. The only external components required are a few resistors and capacitors which enable the user to programme the switch operating frequencies, hysteresis and signal cutoff fail safe delay.

TYPICAL APPLICATIONS

PROCESS MONITORING

REMOTE SWITCHING

TACHOMETRY

FREQUENCY ALARMS

GENERAL OPERATION

The frequency recognition system employed by the FX-701P, 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'. The flip-flop output triggers a dual monostable, which generates reference periods corresponding to set-point f_1 and set point f_2 . These periods are determined by R_1/C_1 and R_2/C_2 .

The reference periods are compared against the signal input period in two comparators, the outputs of which control a special counter/storage system. This counting system discriminates against random/spurious noise information and delivers an output only when a true set point frequency is received. Gating circuits are incorporated which prevent false operation when harmonics of the set point frequencies are applied.

This frequency discrimination system yields extremely sharp set point definition coupled with a fast response time, and a positive 'chatter-free' switch action. As the device monitors all signals applied, care should be taken to ensure that the input does not include noise signals having a frequency lying above the switch set point levels.

FIG. 2. FREQUENCY CALCULATIONS

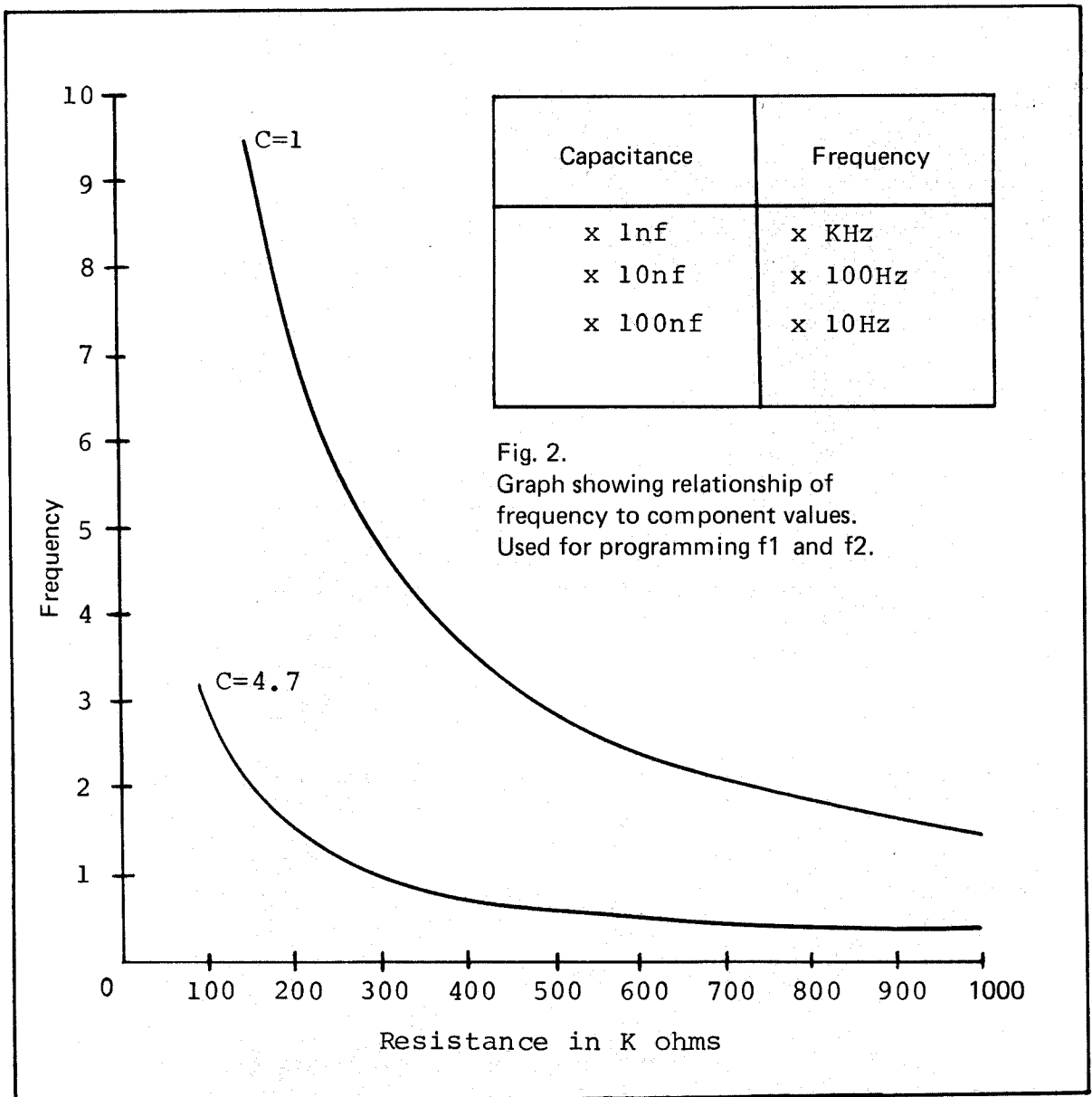


FIG. 3. TRUTH TABLES FX-701P

CONTROL INPUT	OUTPUT SWITCHES		
	HI	INBAND	LO
PIN 1	PIN 9	PIN 10	PIN 11
0	1	1	0 *
1	0	0	1 *

*Showing the active switch for an input signal below f_2 .

LOGIC 1 = +ve SUPPLY LOGIC 0 = GROUND

CONTROL INPUTS		OUTPUT SWITCH FUNCTIONS
PIN 13	PIN 14	
0	0	LATCH OUTBAND
0	1	LATCH HI
1	0	LATCH LO
1	1	UNLATCHED

LATCHING FUNCTIONS

Two latching inputs allow various latching functions to be performed. With both inputs at logic '1' the output switches are 'UNLATCHED' and operate at the relevant set point frequencies, thus reflecting the present value of the signal input frequency. With both inputs at logic '0' 'LATCH OUTBAND' mode, the Hi or Lo output switch will latch if the input signal deviates outside the Inband zone, i.e. over f_1 or below f_2 . Latch Hi mode is obtained by applying a logic '0' to Pin 13 and a logic '1' to Pin 14 this latches the output Hi switch when the signal input lies above f_1 . Latch Lo mode requires a logic '1' on Pin 13 and a logic '0' on Pin 14 thus latching the signal Lo switch when the signal lies below f_2 (see fig. 3).

Once latched, a switch remains in the ON condition regardless of further input signal changes. To unlatch or reset an output switch the signal input must be returned to a non-latch value and a momentary '1' applied to both control pins.

OUTPUT INVERT

Normally this pin is at a logic '0', if it is pulled to positive the polarity of the three output switches are reversed.

Each control input (pins 1, 13, 14) is provided with an internal pull-down resistor which automatically places a '0' level (-ve) on the pin when the pin is open circuit.

FREQUENCY CALCULATIONS F1 & F2

Figure 2 illustrates the component values required for setting f_1 and f_2 , f_1 should always be set to a higher frequency than f_2 , if the component values chosen yield f_2 to be higher than f_1 the inband zone disappears and the output switches change directly from Lo to Hi at the frequency determined by the components used for set point f_1 . The formula for calculating $f_1(R1C1)$ and $f_2(R2C2)$ is $1/0.7RC$ Hz.

OUTPUT SWITCH CHARACTERISTICS

The standard output switch used in all devices is a MOS driver transistor connected between the output pin and the positive pin. No internal load is provided, therefore the only potentials present at the output pins, are those provided by the external load. Low current loads may be directly connected between the output pin and +ve supply, high current loads should be operated through a buffer transistor.

FIG. 4. TIMING DIAGRAM

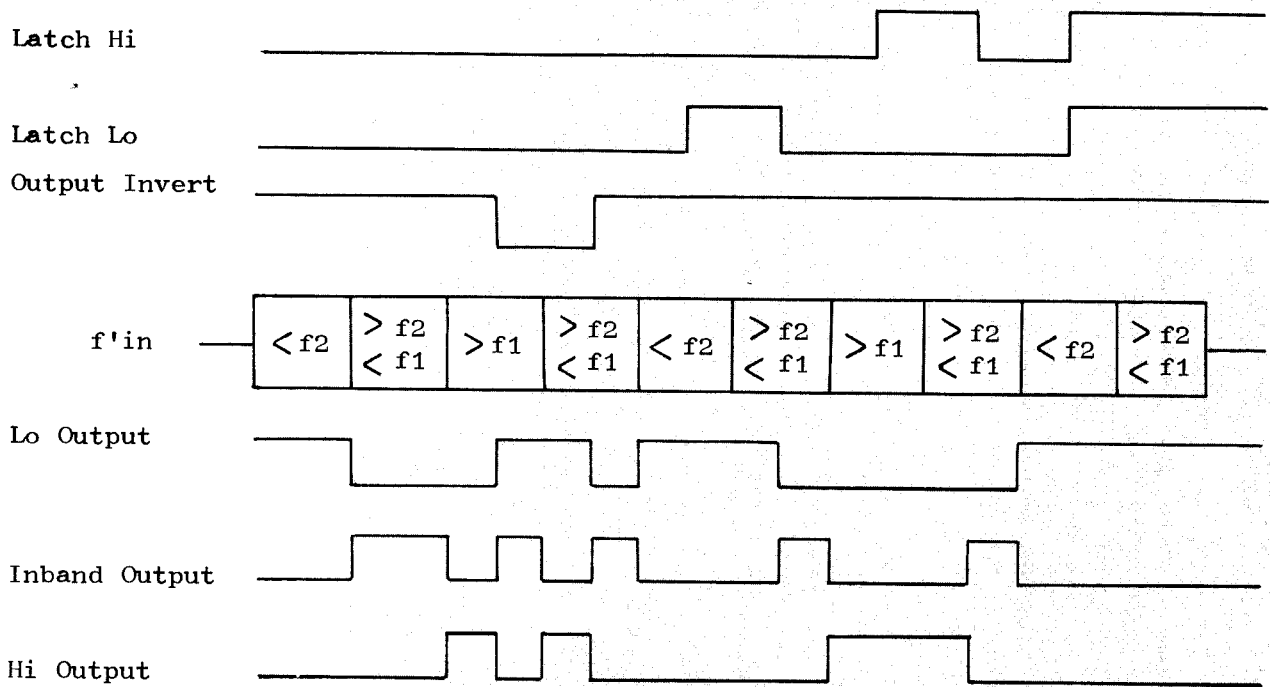


Fig. 4. Timing diagram showing output changes for a typical signal input. Control functions are also shown.

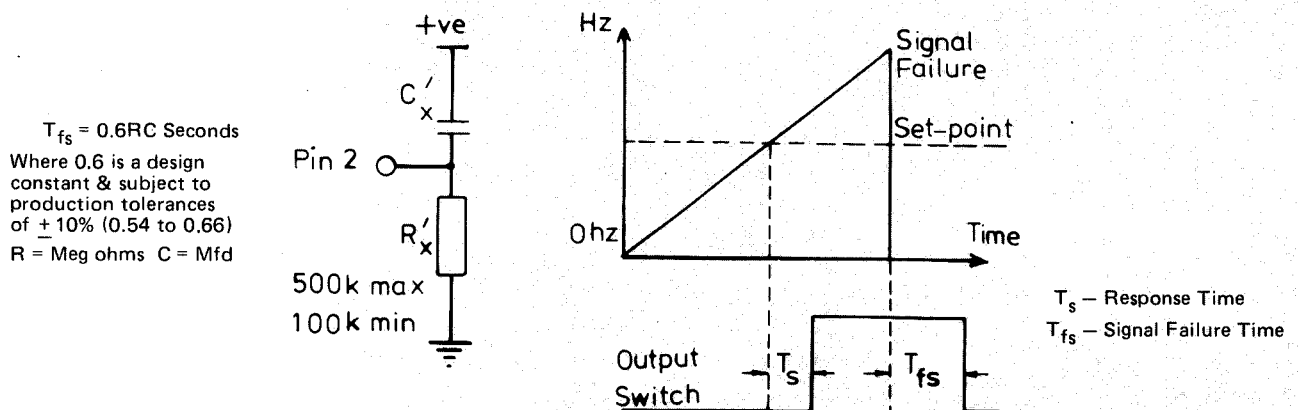
N.B. $f_1 > f_2$

SIGNAL FAILURE RECOGNITION

As the FX-701P is essentially a digital device the input circuits come to rest when no input signals are present. If therefore, an instantaneous signal cut-off occurs while the switch is in the Hi state it will remain in this condition until a low frequency input signal is restored. By suitable connection of Pin 2 however, the reaction of the switch to a failure of input signals can be pre-determined according to user requirements.

With Pin 2 directly connected to the positive supply, the switch ignores signal interruptions and will turn ON or OFF only in response to defined input signal frequencies.

FIG. 5. SIGNAL FAILURE RECOGNITION TIME

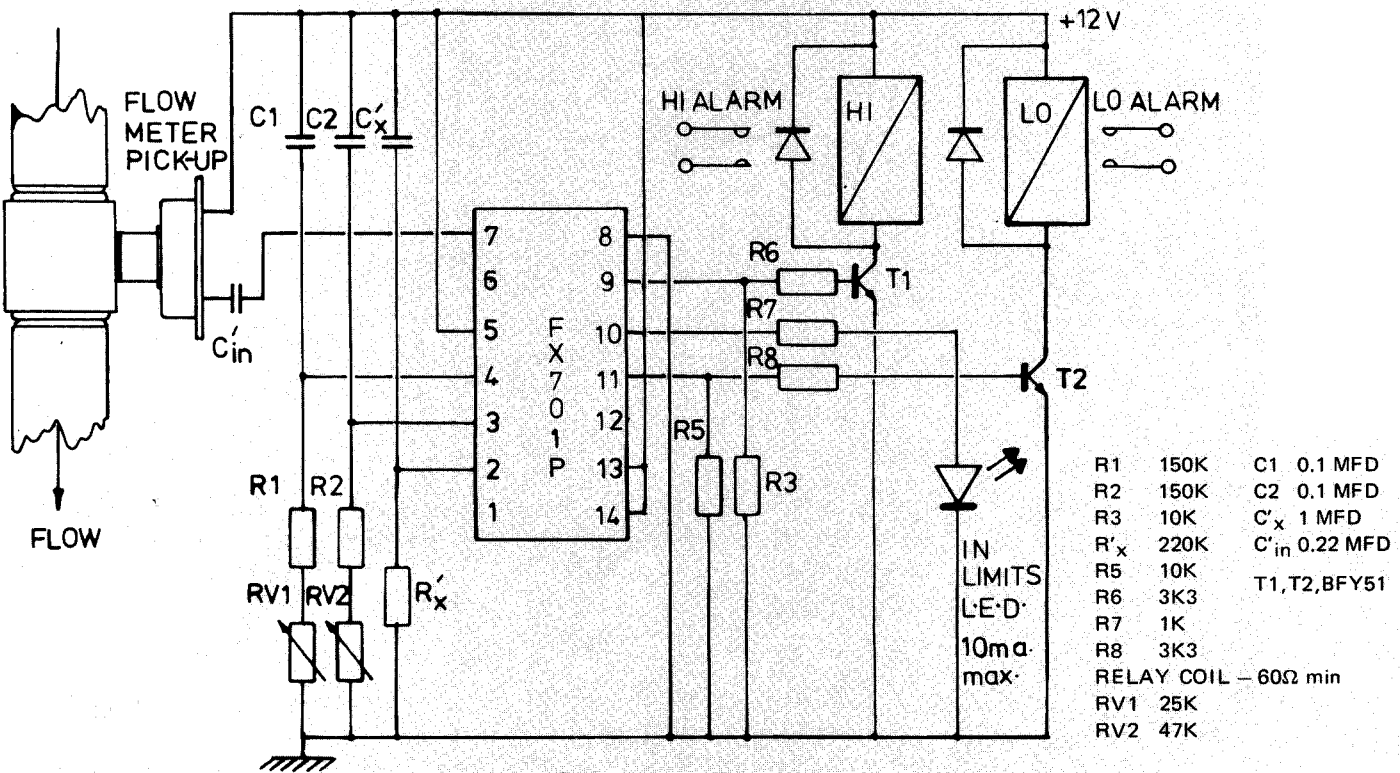


To obtain automatic switch to Lo should input signals fail, Pin 2 should be connected to CR network C'_x/R'_x . If the output switch is in the Hi state and signals fail, the capacitor charges to a preset level and forces the output switch to Lo. The capacitor is then automatically discharged. The failure recognition time T_f can be adjusted to allow phased signal breaks to be ignored, but ensures that the switch adopts the Lo state if a true signal failure occurs.

For general purpose applications a convenient value of T_f is $10/f_2(\text{Hz})$ seconds, which yields a period T_f equal to the normal response time T_s . Whilst T_f can be set to almost any required longer delay time, it should never be made less than $2/f_2(\text{Hz})$ seconds; if it is too short, the interval between successive input signal samples may be mistaken for 'Lo signal' and the switch will be held Lo permanently.

Pin 2 may also be used as a direct reset which switches the outputs to the Lo state, over-riding the input signal. If the pin is open-circuited, the internal pull-up resistor applies a reset voltage to the output switch stages. This resets the switch to Lo state in a maximum time $1/f_2(\text{Hz})$ seconds. Note that the output switch will be permanently Lo if Pin 2 is left open-circuit. See Fig. 5.

FIG. 6. HI/LO/IN-LIMITS FLOWRATE MONITORING



CIRCUIT APPLICATION

Fig. 6 shows how the FX-701P is used to monitor the state of flow of a fluid in a pipe. By means of a flow rate transducer, a signal of varying frequency is obtained. The circuit then processes this information to indicate when the flowrate is within pre-set limits or whether it is above or below them.

In the example shown, when the frequency from the transducer is between f_2 and f_1 , (80Hz and 90Hz) the IN-LIMITS LED is illuminated. When the frequency rises over f_1 the HI alarm relay operates and if it falls below f_2 the LO alarm relay operates. Only one output is on at a time and the set point thresholds are very sharp (0.1% differential typical). With pins 13 and 14 connected to the positive rail this gives an unlatched mode of operation. If pin 1 is connected to the positive rail, this causes the outputs to reverse, i.e. the LED is on only for outband signals and both relays operate for any signal between f_2 and f_1 . If there is a signal failure, R'_x/C'_x ensures that the switches adopt a LO state.

SPECIFICATIONS

MAX. RATINGS

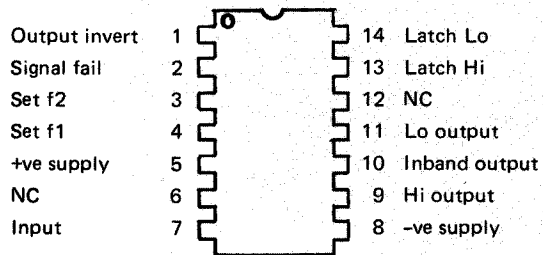
Max. voltage between any pin and negative supply	20V & -0.3V
Operating Temperature Range	-10°C to 60°C
Storage Temperature Range	-40°C to 85°C
Max. Output Switch Load Current	10mA each switch
Max. Device Dissipation at 20°C (T'amb)	200mW

CHARACTERISTICS

(T'amb = 20°C, Vdd = 12V ± 2V, Set Point Frequencies 1Hz to 3KHz (unless specified))

SYMBOL	PARAMETER	CONDITIONS & NOTES		MIN	TYP	MAX	UNITS
Vdd	Supply voltage	Operating range		8	12	15	V
Idd	Supply current	Total excluding switch load current			3.5		mA
V'in	Signal Amplitude range	Sine or square wave AC coupled			0.1	15	V pk-pk
f1/f2	Adjustment limits	Max & min set point frequencies		1Hz		10KHz	
	Frequency ratio	Permitted ratio adjustment (f2% below f1)		1		95	%
Δf	Set point stability	Set point deviation versus supply volts & T'amb. External component coeff excluded	Supply		0.05	0.08	%/%
			T'amb		0.005	0.02	%/°C
Tr	Response time	Overall switching time following receipt of 'switch' value frequency		$\frac{8}{f'o}$			Secs.
R'on	Switch 'ON' resistance	Internal resistance between output pin and ground switch 'ON' (Switch 'OFF' resistance ≥ 10M Ω)			0.3	1	KΩ
'1'	Logic High	External logic levels to control inputs. '1'		6		15	V
'0'	Logic Low	(Internal 300KΩ pull-down resistors give logic '0' when open circuit) '0'		0		1.5	V

PIN CONNECTIONS



PACKAGE DETAILS: 14 LEAD D-I-L.

