VECTRON
INTERNATIONAL
A DOVER COMPANY

FX-104
Frequency Translator

Features
- **Output frequencies up to 777.60 MHz**
- **Jitter Generation OC-192 compliant**
- **Jitter transfer per GR-253-CORE**
- **Single 5 or 3.3 Vdc supply**
- **Locked to specified Input frequency, e.g. 8 kHz**
- **1" x 0.8" x 0.25", Surface Mount (FR4 base)**

Applications
- **SONET / SDH / ATM**
- **DWDM / FDM**
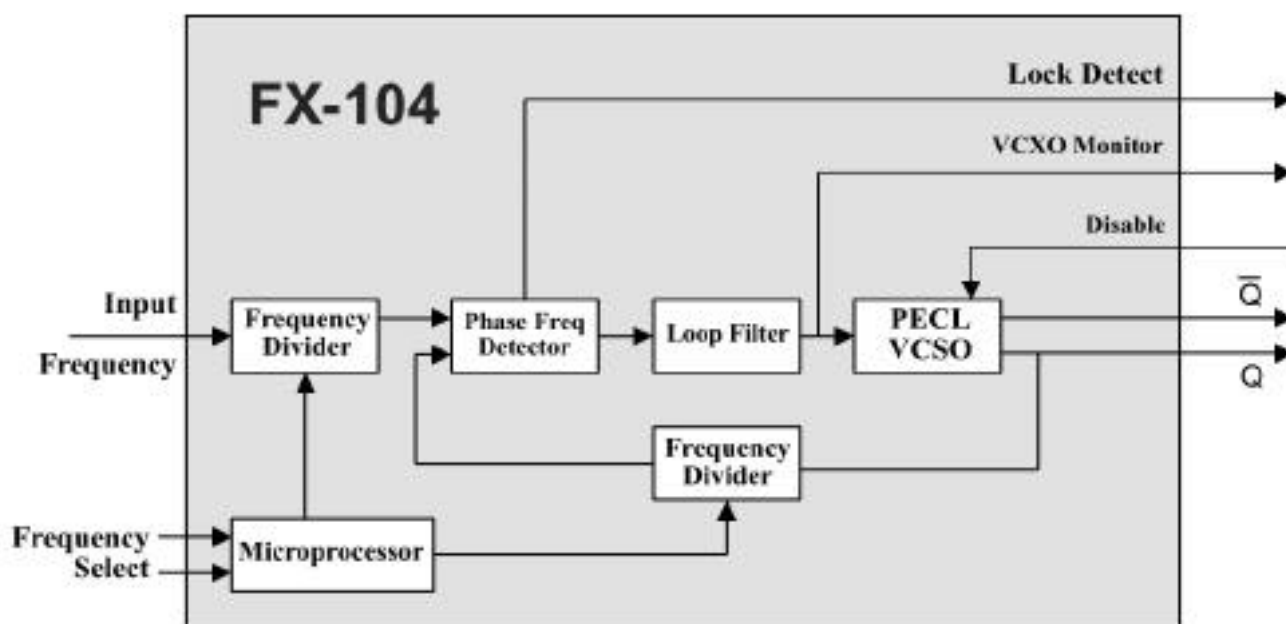- **DSL-PON Interconnects**
- **FEC (Forward Error Correction)**

FX-104 Frequency Translator

Description

Vectron's FX-104 is a SAW based frequency translator which is used to translate any input frequency such as 8 kHz, 1.544 MHz, 2.048 MHz, 19.440 MHz etc. to any specific frequency from 170 MHz to 777.6 MHz. The input frequency does not have to be a 50/50% duty cycle and as an example can be an 8 kHz signal with a logic high "on time" of only 1us, such as a BITS clock. The FX-104 also has the ability to translate any of 1 to 4 different input frequencies to one common output frequency, such as input frequencies of 8 kHz and 1.544 MHz and 19.44 MHz and any other frequency between 333 Hz and 170 MHz translating them to any specific output frequency from 170 MHz to 777.600 MHz.
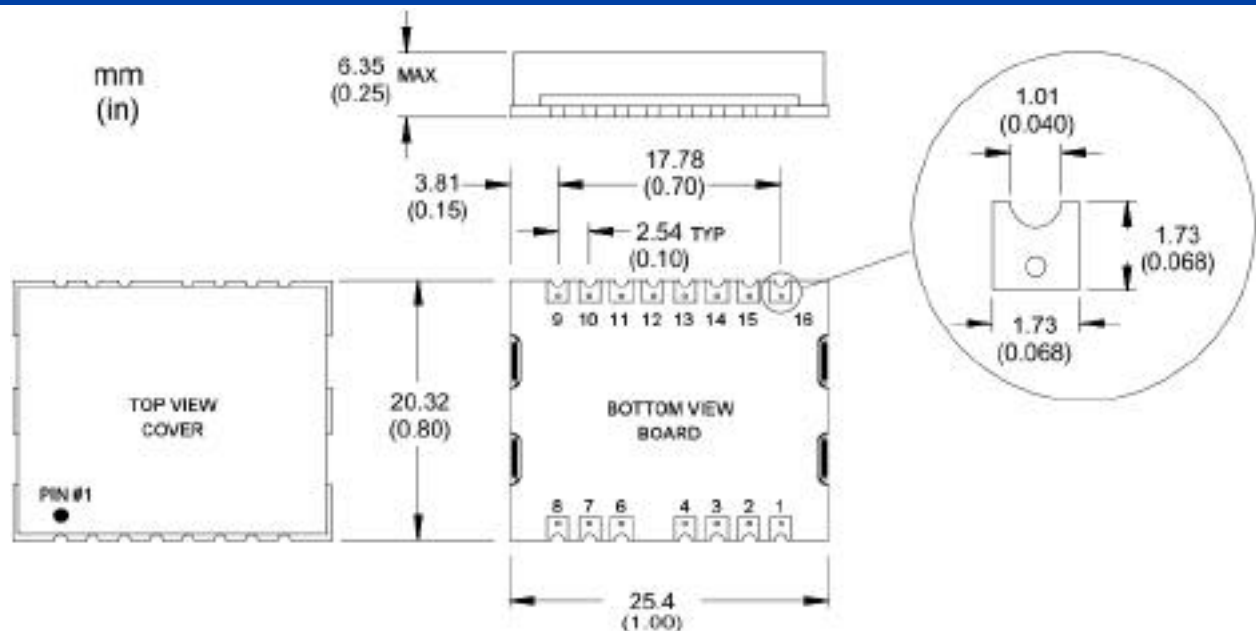
The "Input Frequency tracking capability" is the total amount of input frequency deviation in which the FX-104 is guaranteed to track or translate. As an example, a typical input clock would be 8 kHz ±20 ppm. The FX-104 is guaranteed to track at least ±40 ppm of error over temperature/ aging/ power supply and is more than twice what most applications require. The PLL control voltage is brought out through a 470K ohm resistor. This would allow for the use of external circuitry (analog comparators or an A/D converter plus a processor) to detect when the control voltage is getting close to the limits of the pull range.

Performance Characteristics

Parameter		Symbol	Min	Typical	Max	Unit
Output Frequencies			155.52		777.6	MHz
Supply Voltage,	**C** = 5 Vdc	V_{CC}	4.75	5.00	5.25	Vdc
	D = 3.3 Vdc	V_{CC}	3.15	3.30	3.45	Vdc
Supply Current		I_{CC}		95	125	mA
Input Signal,	**A** = HCMOS	CLKIN		HCMOS		---
	D = PECL	CLKIN		PECL		---
OUTPUT,	**F** = Comp PECL	---	---	PECL	---	---
V_{OL}		V_{OL}	V_{CC}-1.95		V_{CC}-1.63	V
V_{OH}		V_{OH}	V_{CC}-0.98		V_{CC}-0.75	V
Rise/Fall Time (20% to 80%)		t^R/t^F		250	400	ps
Output Symmetry		Sym	45	49/51	55	%
Jitter Generation, rms (12 kHz to 20 MHz)				0.23	1	ps
Jitter Generation, rms (cycle to cycle method)				3	5	ps
Jitter Transfer, GR-253-CORE sec 5.6.2.1.2					0.1	dB
Input Frequency Tracking Capability (Can translate a Stratum 1,2,3,3E,4 or SONET Min source)		APR	±40			ppm
Operating Temperature		Temp Range **C** = 0°C to +70°C Temp Range **F** = -40°C to +85°C				
Size		25.4 x 20.32 x 6.35 mm (1.0" x 0.8" x 0.25")				

Vectron International • 267 Lowell Road, Hudson, NH 03051 • Tel: 1-88-VECTRON-1 • Web: www.vectron.com

Outline Drawing

Pin Out

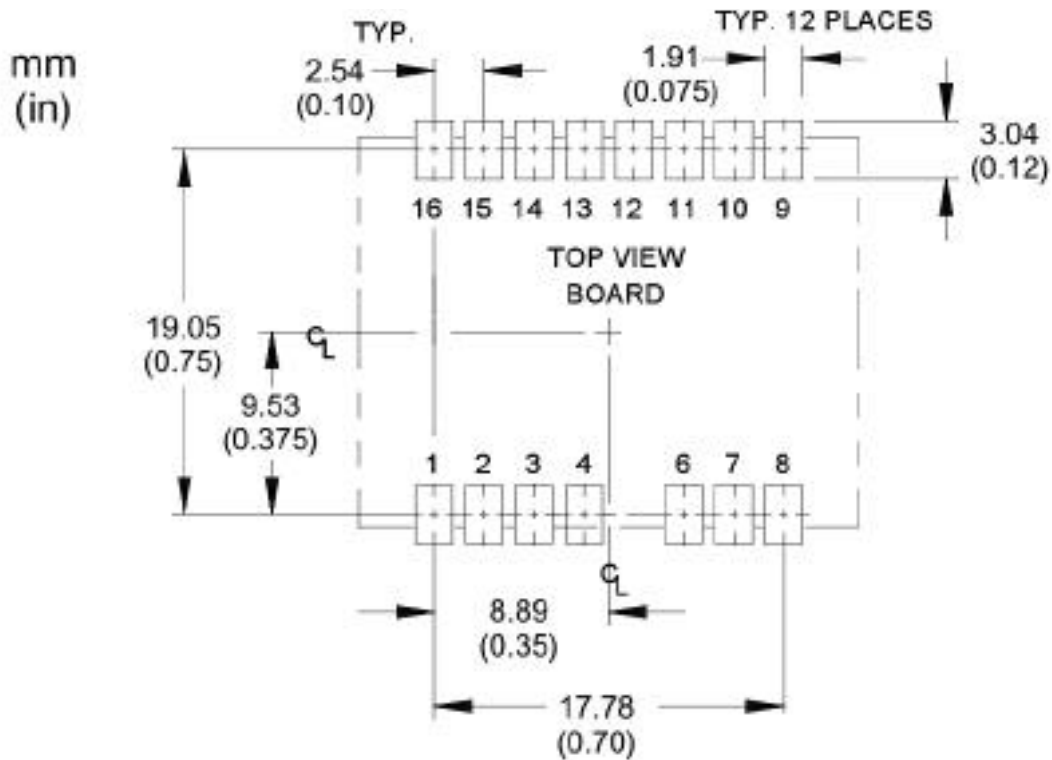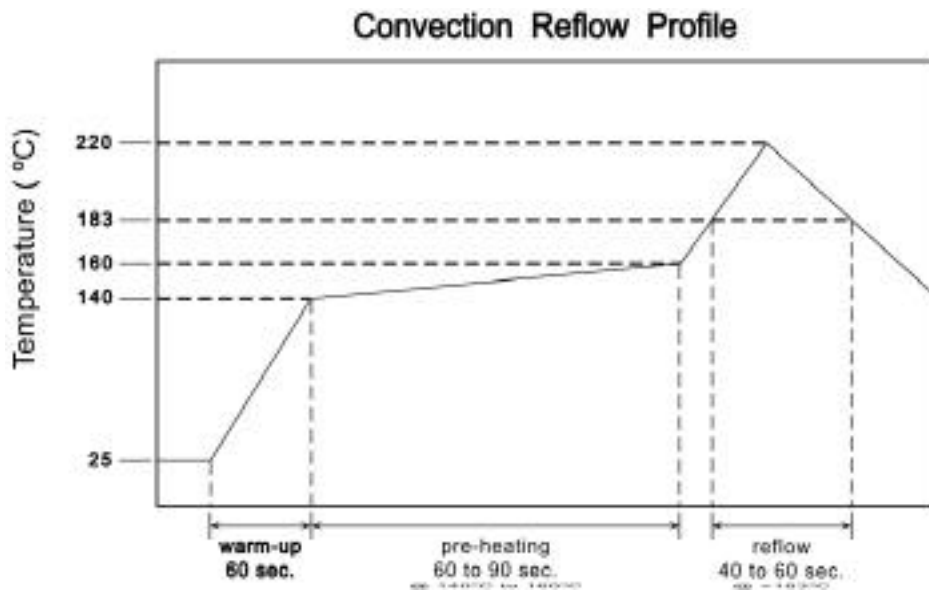| Pin	Symbol	Function
1	CLKIN	**Input Frequency** - The FX-104 series AC couples the input, this means the unit is capable of handling HCMOS, LvHCMOS, PECL and LvPECL input signals. (For Input Frequencies below 1 MHz only HCMOS and LvHCMOS are supported)
2	GND	Ground
3	LD (output)	Lock Detect Logic "1" indicates a locked condition Logic "0" indicates that no input signal is present or the input signal has moved out of the lock range.
4	Monitor (Output)	PLL/ VCXO control voltage Under locked conditions, should be >0.3V and <3.0V for the 3.3 volt option or >0.5V and <4.5V for the 5 volt option. Input frequency may be out of range if voltage exceeds these limits.
5	---	Missing
6	NC	No Connection
7	GND	Ground
8	Enable Disable	No connect = Output enabled Logic "0" = Output disabled
9	Out	Output
10	COUT	Complementary Output
11	NC	No Connection
12	Select A	Do not Exceed Vcc
13	Select B	Do not Exceed Vcc
14	NC	No Connection
15	GND	Ground
16	V_{cc}	Power Supply Voltage (5 Vdc or 3.3Vdc)

Vectron International • 267 Lowell Road, Hudson, NH 03051 • Tel: 1-88-VECTRON-1 • Web: www.vectron.com

FX-104 Frequency Translator

Pad Layout

mm (in)

TYP.
2.54 (0.10)

TYP. 12 PLACES
1.91 (0.075)

3.04 (0.12)

16 15 14 13 12 11 10 9

TOP VIEW
BOARD

19.05 (0.75)

9.53 (0.375)

1 2 3 4 6 7 8

8.89 (0.35)

17.78 (0.70)

Recommended Reflow Profile

Convection Reflow Profile

Temperature (°C)

220
183
160
140
25

warm-up
60 sec.

pre-heating
60 to 90 sec.

reflow
40 to 60 sec.

NOTE: The FX-100 series should not be subjected to a wash process that will immerse it in solvents. NO CLEAN is the recommended procedure. The FX-100 series has been designed for pick and place reflow soldering. The suggested reflow profile is shown above. The FX-100 series may be reflowed once, and should not be reflowed in the inverted position.

Vectron International • 267 Lowell Road, Hudson, NH 03051 • Tel: 1-88-VECTRON-1 • Web: www.vectron.com

Standard Shipping Method

The Standard ship method for volume production of the FX-100 series is in a matrix tray. These trays are 100% recyclable. The trays also offer the added feature that they can be continuously feed into a pick-n-place machine eliminating the down time required with tape-n-reel.
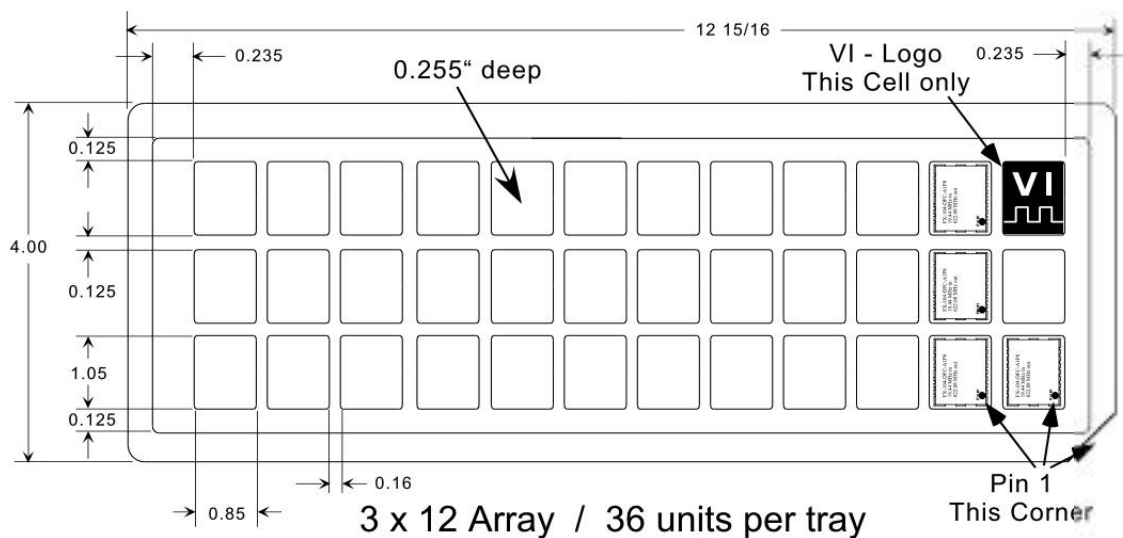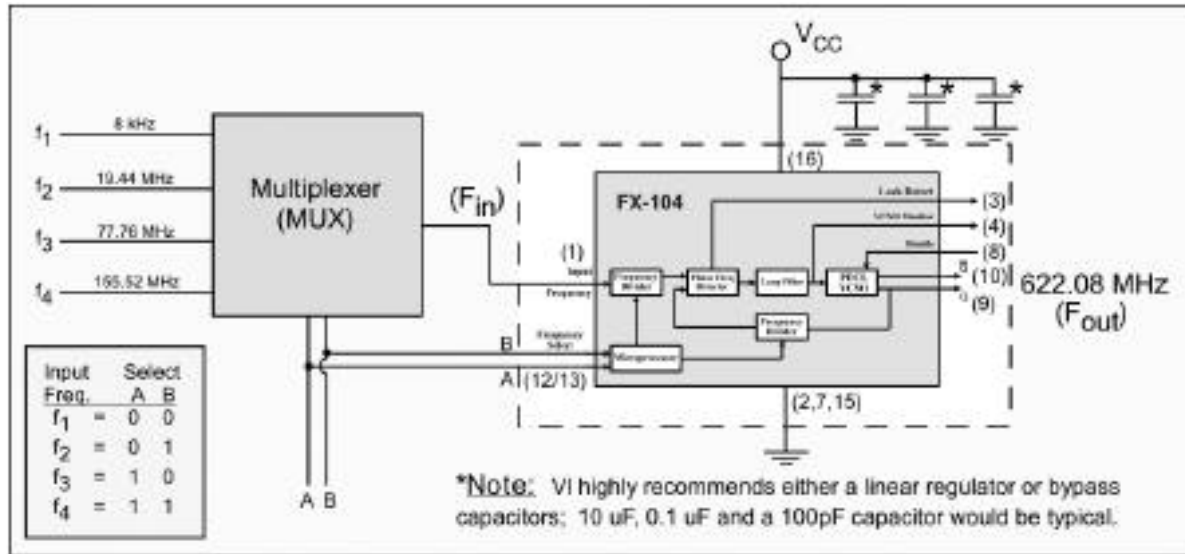

Handling Precautions

Although protection circuitry has been designed into this device, proper precautions should be taken to avoid exposure to electrostatic discharge (ESD) during handling and mounting. VI employs a human-body model (HBM) for ESD-susceptibility testing and protection design evaluation.

ESD voltage thresholds are dependent on the circuit parameters used to define the mode. The HBM ESD threshold presented here was obtained by using parameters where resistance = 1500 ohms, capacitance = 100pf)

ESD Threshold Voltage		
Model	Threshold	Unit
Human Body (HBM)	500	V min

Vectron International • 267 Lowell Road, Hudson, NH 03051 • Tel: 1-88-VECTRON-1 • Web: www.vectron.com

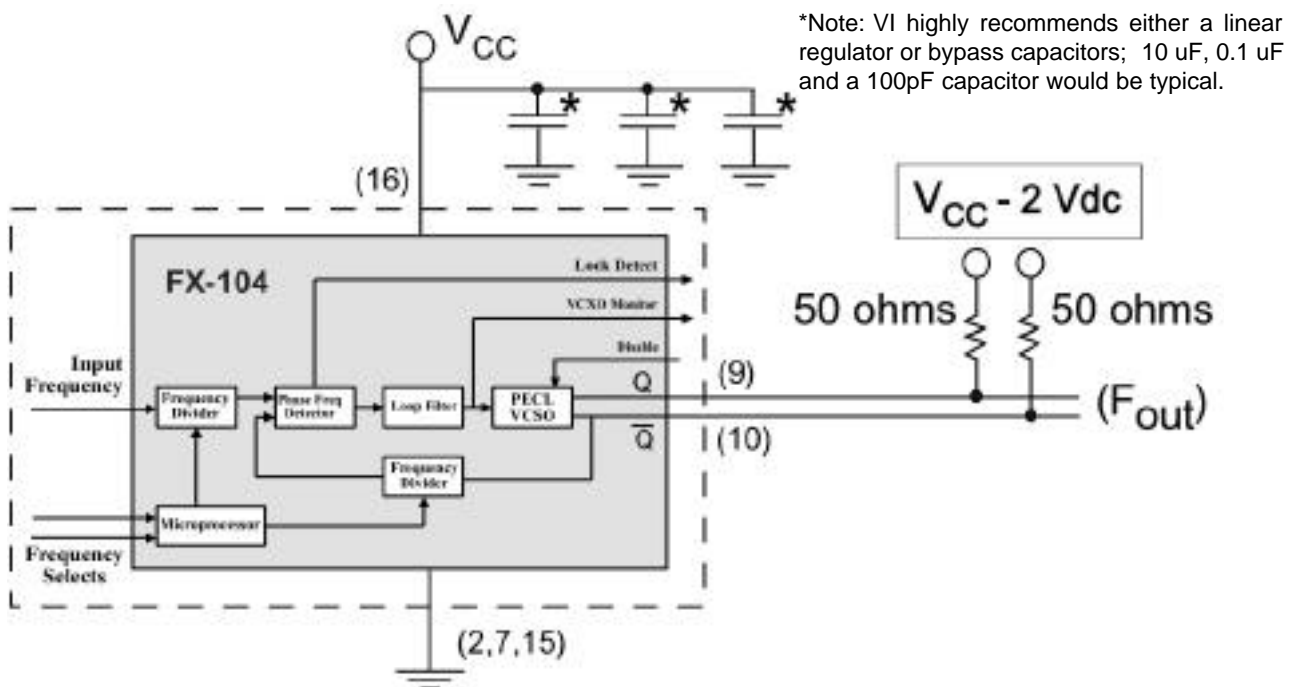# FX-104 Frequency Translator

All components outside the dotted line box are user supplied components. This is just one possbile configuration of the FX-104. For additional information about your specific needs, please contact our factory.

Output Load Configuration

*Note: VI highly recommends either a linear regulator or bypass capacitors; 10 uF, 0.1 uF and a 100pF capacitor would be typical.

All components outside the dotted line box are user supplied components and/or connections. This is just one possible configuration of the FX-104. For additional information about your specific needs please contact our Factory.
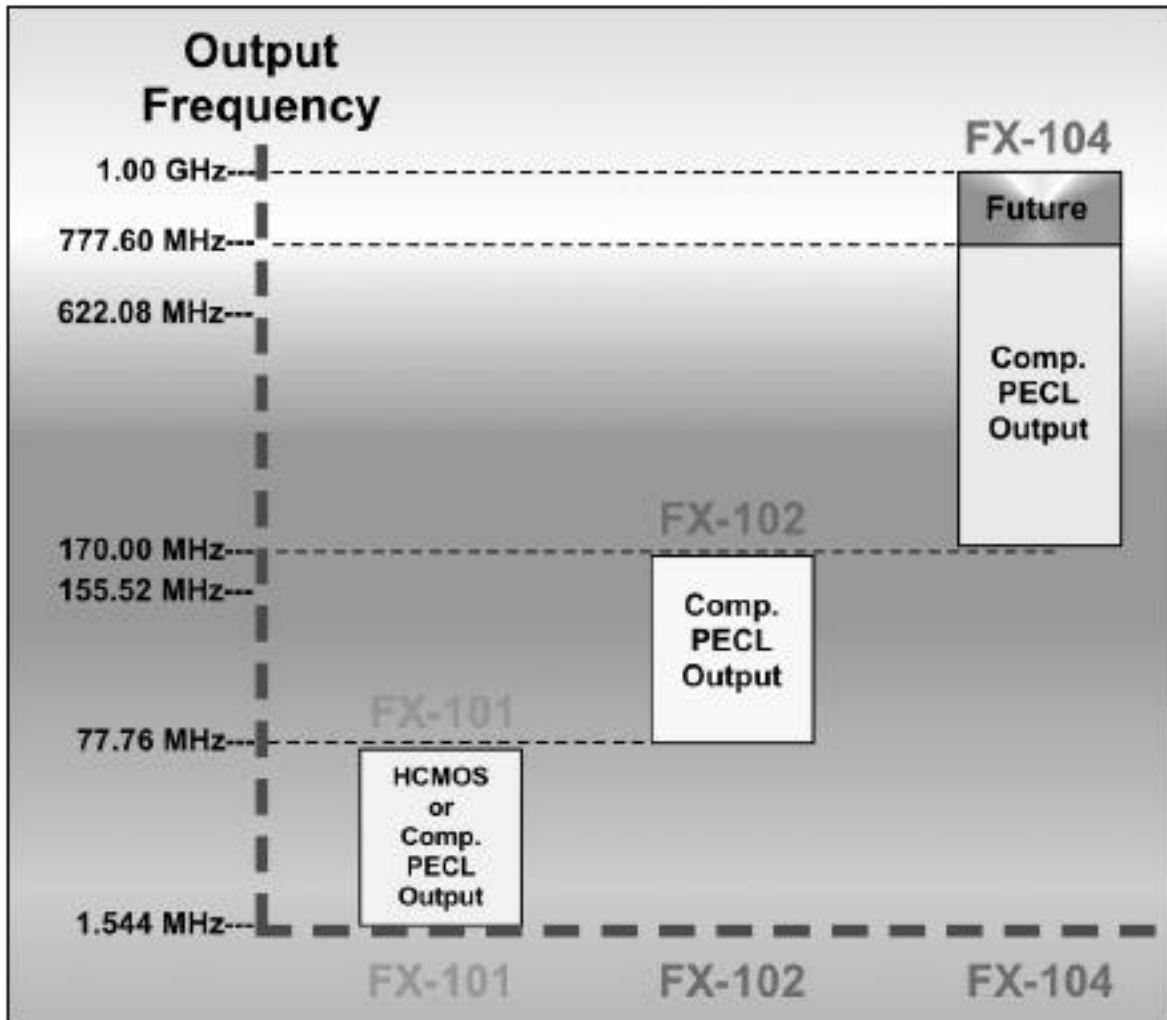
Vectron International • 267 Lowell Road, Hudson, NH 03051 • Tel: 1-88-VECTRON-1 • Web: www.vectron.com

FX-100 Series Selection Guide

FITS / MTBF Calculations

Per Bellcore TR-NWT-000332, GF @ +50⁰C.

Typical - FX-104-DFC-A1P8

FITs = 316.88

MTBF (Hours) = 3,155,819

Vectron International • 267 Lowell Road, Hudson, NH 03051 • Tel: 1-88-VECTRON-1 • Web: www.vectron.com

FX-104 Frequency Translator

FAQ's

Q: What are the different input frequencies that are available?
**A: The FX-100 series is able to handle any input frequency between 8 kHz and 170 MHz.
(A list of standard frequencies is available on pages 9 & 10)**

Q: How many different input frequencies can a specific FX-104 accept?
A: Each FX-104 can be programmed to accept up to 4 different frequencies.

Q: If there is only one input pin, how can your unit accept 4 different frequencies?
**A: The user is required to supply a multiplexer which would switch between the different input
frequencies. The multiplexers' select pins would need to be sync'd to the select pins of the FX-104.
(See The Typical Application illustrated on page 6)**

Q: Can a single FX-104 handle an application for 4 input frequencies of 8 kHz, 19.44, 77.76 and 155.52 MHz
all being translated to 622.08 MHz, with the 155.52 MHz input being LvPECL and the others HCMOS?
A: Yes; since the FX-104 AC couples the input signal, this combination can be supported.

Q: What is the lock time for the FX-104?
**A: The exact lock time will depend on the specific input frequency. It should be noted that in all cases
the lock time will be significantly less than 1 second.**

Q: I asked for a FX-104-DFC-A2S8 with 19.44 and 155.52 MHz for the input frequencies and was given a
Source Control Drawing (SCD) number of FX-104-DFC-S5999. Why was a new number assigned?
**A: Whenever there are multiple input frequencies, we need to assign a SCD for the unit so that we can
include a table indicating what the logic levels need to be on pins 12 and 13 to control the unit per
the correct input frequency.**

Q: What are the exact jitter transfer specs that the FX-104 series meets?
**A: The FX-104 meets the stringent jitter transfer specs in GR-253 for Category II jitter (Section 5.6.2.1.2)
for all OC-n levels.**

Q: My circuit card is already laid out for the FX-102, Is the FX-104 footprint compatible?
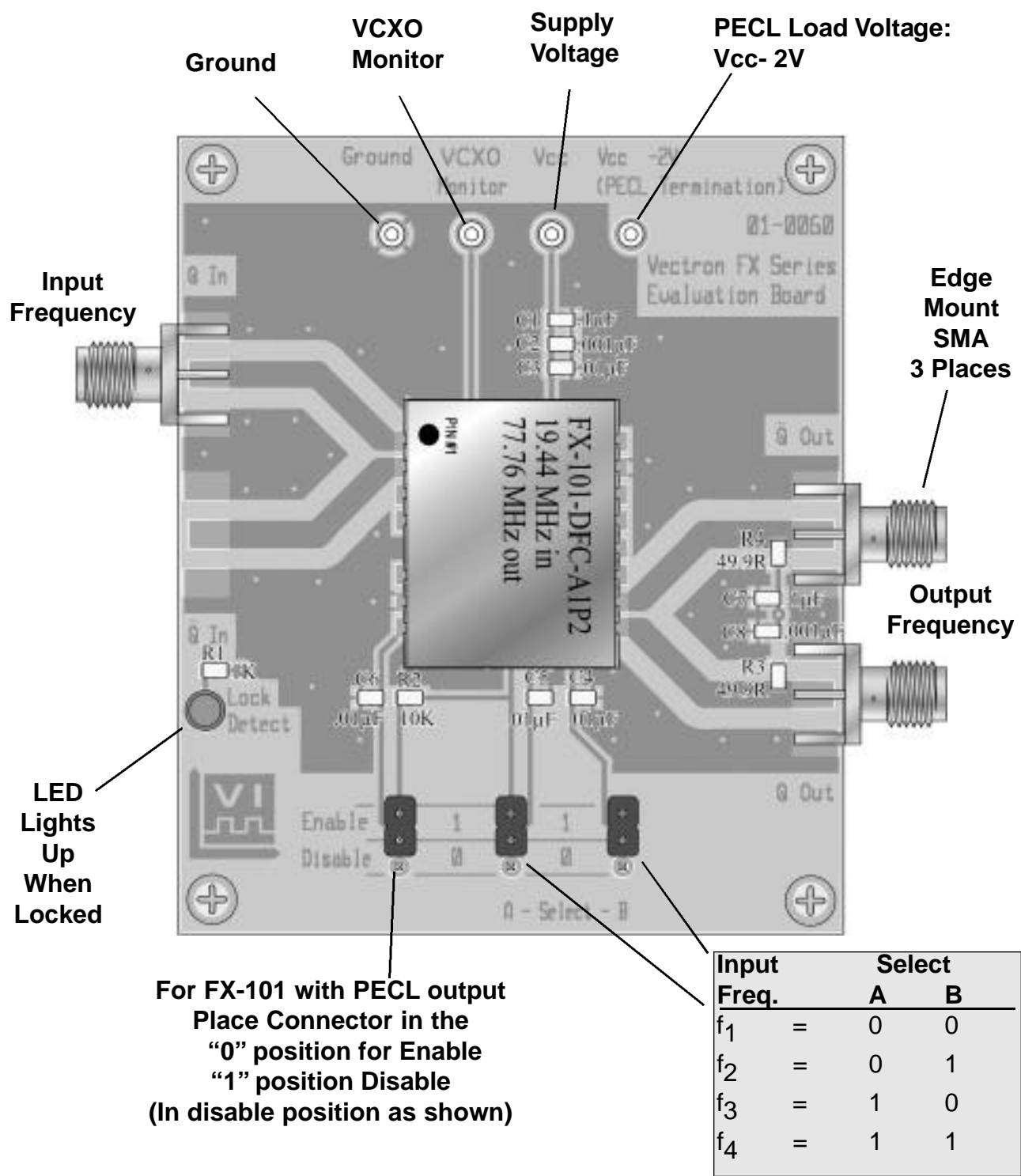**A: Yes; The FX-104 package is a drop in replacement for the FX-102 package. The only difference is in
the logic level for the Output Disable/Enable pin. They are opposite between the FX-102 and FX-104.
However letting pin 8 float will allow both units to be enabled.**

Q: What type of noise on the supply line can the FX-104 suppress?
**A: The FX-104 is designed to clean up noise on the Input Clock Signal, it is not designed to clean up
noisy power supplies. If excessive noise is present on the supply line it may degrade the output jitter
performance. Additional external filtering may be required. Please consult with your power supply
vendor on the best way to filter noise on your supply line.**

Evaluation Board

Ground

VCXO Monitor

Supply Voltage

PECL Load Voltage: Vcc- 2V

Input Frequency

Edge Mount SMA 3 Places

Output Frequency

LED Lights Up When Locked

For FX-101 with PECL output Place Connector in the "0" position for Enable "1" position Disable (In disable position as shown)

Input Freq.		Select A	B
f_1	=	0	0
f_2	=	0	1
f_3	=	1	0
f_4	=	1	1

Evaluation boards are available upon request.

Vectron International • 267 Lowell Road, Hudson, NH 03051 • Tel: 1-88-VECTRON-1 • Web: www.vectron.com

FX-104 Frequency Translator

Other Standard Input / Output Combinations

Input 1	Input 2	Input 3	Input 4	Output
12.8 MHz	----	----	----	622.08 MHz
19.44 MHz	51.84 MHz	155.52 MHz	----	622.08 MHz
22.2171 MHz	44.4343 MHz	77.76 MHz	----	622.08 MHz
8 kHz	22.2171 MHz	155.52 MHz	----	622.08 MHz
8 kHz	19.44 MHz	77.76 MHz	155.52 MHz	622.08 MHz
10 MHz	155.52 MHz	----	----	622.08 MHz
19.44 MHz	38.88 MHz	77.76 MHz	155.52 MHz	622.08 MHz
22.217142 MHz	----	----	----	622.08 MHz
125 MHz	----	----	----	625.00 MHz
156.25 MHz	----	----	----	625.00 MHz
20.1416 MHz	----	----	----	644.5313 MHz
161.1328 MHz	----	----	----	644.5313 MHz
19.44 MHz	38.88 MHz	77.76 MHz	----	666.5143 MHz
22.2171 MHz	----	----	----	666.5143 MHz
77.76 MHz	----	----	----	666.5143 MHz
20.1416 MHz	----	----	----	690.5692 MHz

The combinations above are just a small sample of what is possible with the FX-104 series.

The FX-104 uses Vectron International's VS-500 VCSO and as such can support any output frequency that is available with the VS-500. The list below shows the available frequencies for the VS-500.

Vectron International will support all FEC rates for SONET, 10 GigB and 10.3125 GigB applications. If you do not see a frequency option listed that you need, please contact the factory.

When ordering FEC rates, we ask that you also include the FEC ratio (e.g. 255/237 x OC-3, 237/236 x OC-3,etc....) for both the input and output frequencies.

VS-500 Available Frequencies (MHz)

155.5200	156.2500	161.1328	166.6286
177.7371	311.0400	622.0800	624.7048
625.0000	627.3296	644.5313	666.5143
669.1281	669.3265	690.5692	719.73439
765.5906	767.2500	777.6000	

Vectron International • 267 Lowell Road, Hudson, NH 03051 • Tel: 1-88-VECTRON-1 • Web: www.vectron.com

FX-104 Frequency Translator

Standard Frequencies

8 kHz	**C**	19.44 MHz	**P**	112 MHz	**4**
16 kHz	**D**	20.48 MHz	**R**	139.264 MHz	**5**
64 kHz	**E**	26.00 MHz	**T**	155.52 MHz	**6**
1.024 MHz	**F**	27.00 MHz	**W**	166.6286 MHz	**7**
1.544 MHz	**H**	38.88 MHz	**X**	622.08 MHz	**8**
2.048 MHz	**J**	44.736 MHz	**Y**	666.5143 MHz	**9**
4.096 MHz	**K**	51.84 MHz	**0**		
8.192 MHz	**L**	61.44 MHz	**1**		
13.00 MHz	**M**	77.76 MHz	**2**		
16.384 MHz	**N**	82.944 MHz	**3**	Special SCD	**S**

How to Order

FX-104 - D F C **-** A 1 P 8

Supply Voltage
C = 5 Vdc ±5%
D = 3.3 Vdc ±5%

Output Type
F = Comp. PECL

Temperature Range
C = 0°C to +70°C
F = -40°C to +85°C

*If not listed or more than one input frequency a special SCD number will be assigned at point of order.

Output Frequency (6 to 9)
See Frequency Chart Above
*If not listed enter **S** in this block and then list the output frequencies after the part number.

Input Frequency (C to 7)
See Frequency Chart Above
*If not listed or more than one frequency enter **S** in this block and then list all the input frequencies after the part number.

Number of Input Frequencies
1 = 1 Input Frequency
2 = *2 Input Frequencies
3 = *3 Input Frequencies
4 = *4 Input Frequencies

Input Logic
A = HCMOS
D = PECL

Part Number Examples:
FX-104-DFC-D128
*FX-104-DFF-A4S2, S = 8 kHz, 19.44 MHz, 77.76 MHz, 155.52 MHz
*FX-104-CFC-A1PS, S = 625 MHz

Vectron International • 267 Lowell Road, Hudson, NH 03051 • Tel: 1-88-VECTRON-1 • Web: www.vectron.com

FX-104 Frequency Translator

Visit Our Website at
www.vectron.com

Vectron International • 267 Lowell Road, Hudson, NH 03051 • Tel: 1-88-VECTRON-1 •   **REV 18Oct01, 20Aug02**