VECTRON INTERNATIONAL
A DOVER COMPANY

# FX-702

Low Jitter VCSO Frequency Translator
Previous Part Number FX-730

Helping Customers Innovate, Improve & Grow


## Description

The FX-702 is a low jitter precision frequency translator used to translate input frequencies such as 19.44, 38.88, 77.76 MHz, etc. to a binary multiple frequency as high as 850 MHz. The FX-702's superior jitter performance is achieved through the PLL's integrated VCSO. The FX-702 is housed in a hermetically sealed leadless surface mount package offered on tape and reel.

## Features

- 5 x 7.5 x 2.5 mm Package
- Frequency Translation up to 850 MHz
- VCSO based PLL for Ultra-Low Jitter
- CMOS / LVDS / LVPECL Inputs compatible
- Differential LVPECL or LVDS Output
- CMOS Lock Detect
- External Divider for Input Frequencies < 19 MHz
- 0°/70°C or -40°/+85°C Temperature Range
- Fully Compatible for Lead Free Assembly



## Applications

- SONET/SDH
- 10GbE./10.3GbE
- Frequency Translation
- Clock Smoothing, Clock Switching
- FEC Scaling

## Block Diagram

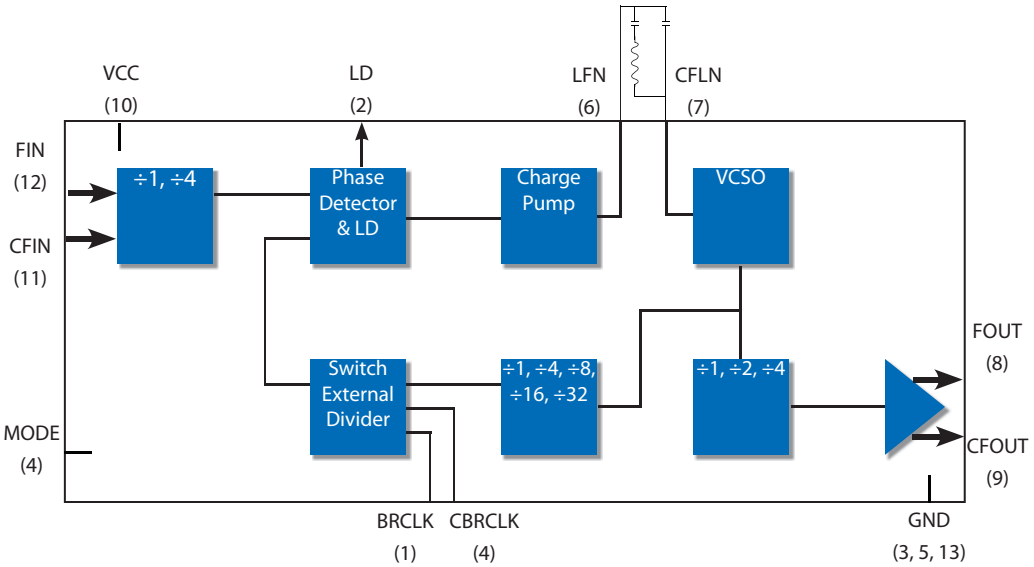


*Figure 1. Functional block diagram*


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

# Performance Specifications

**Table 1. Electrical Performance**

| Parameter | Symbol | Min | Typical | Maximum | Units |
|---|---|---|---|---|---|
| Frequency [1, 2, 3] | | | | | |
| Input Frequency | $F_{IN}$ | 19.44 | | 850 | MHz |
| Output Frequency | $F_{OUT}$ | 125 | | 850 | MHz |
| Capture Range (ordering option) [1, 2, 3] | APR | ±32, ±50, or ±100 | | | ppm |
| Supply | | | | | |
| Voltage [2, 3] | $V_{CC}$ | 2.97 | 3.3 | 3.63 | V |
| Current (No Load) [3] | $I_{CC}$ | | | 100 | mA |
| LVCMOS Input [2, 3] | | | | | |
| Input High Voltage | $V_{IH}$ | 2.0 | | $V_{CC}$ | V |
| Input Low Voltage | $V_{IL}$ | 0 | | 0.8 | V |
| LVPECL Input | | | | | |
| Peal-Peak Amplitude Swing [6, 7] | | 0.20 | | 3.00 | V |
| Lock Detect Output | | | | | |
| Output High Voltage | $V_{OH}$ | 0.9*$V_{CC}$ | | | V |
| Logic Low Voltage | $V_{OL}$ | | | 0.1*$V_{CC}$ | V |
| Outputs | | | | | |
| Mid Level - LVPECL [2, 3] | | $V_{CC}$-1.4 | $V_{CC}$-1.25 | $V_{CC}$-1.0 | V |
| Swing - LVPECL [2, 3] | | 450 | 600 | 950 | mV-pp |
| Mid Level - LVDS [2, 3] | | | $V_{CC}$-1.2 | | V |
| Swing - LVDS [2, 3] | | 250 | 450 | | mV-pp |
| Current [5] | $I_{OUT}$ | | | 20 | mA |
| Rise Time [4, 5] | $t_R$ | | | 400 | ps |
| Fall Time [4, 5] | $t_F$ | | | 400 | ps |
| Symmetry [2, 3] | SYM | 45 | 50 | 55 | % |
| Jitter Generation - 622.08MHz output | | | | | |
| (12kHz-20MHz BW) [5] | $\Phi_J$ | | 0.21 | 0.5 | ps-rms |
| (50kHz - 80MHz BW) [5] | $\Phi_J$ | | 0.12 | 0.4 | ps-rms |
| Operating Temp (ordering option) [1, 3] | $T_{OP}$ | 0/70, -40/85 | | | ºC |

1. *See Standard Frequencies and Ordering Information.*
2. *Parameters are tested with production test circuit below (Fig 1).*
3. *Parameters are tested at ambient temperature with test limits guard banded for specified operating temperature.*
4. *Measured from 20% to 80% of a full output swing (Fig 2).*
5. *Not tested in production, guaranteed by design, verified at qualification.*
6. *Minimum Input Low Voltage not to exceed 2.125 V. Minimum Input High Voltage not to go below 1.49 V.*
7. *AC coupling is recommended. There is an internal pull-up and pull-down resistor on all clock inputs (Fin, BRCLK).*



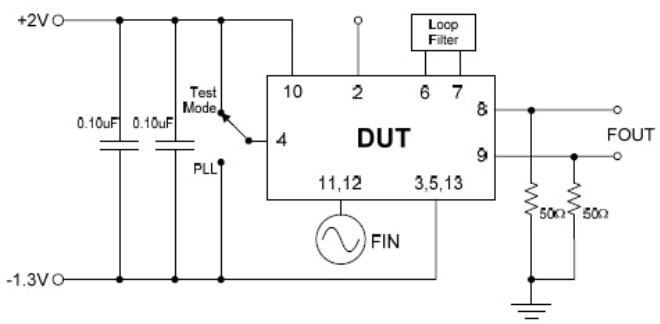


*Figure 1. LVPECL Test Circuit*

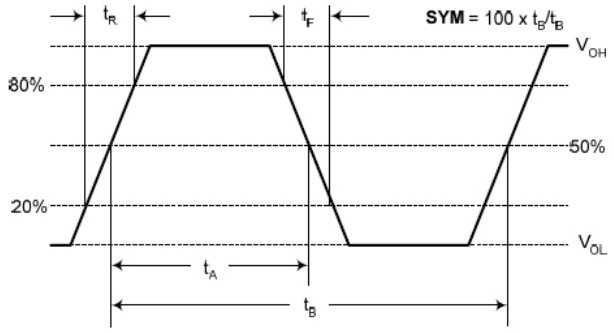


*Figure 2. 10K LVPECL Waveform*

## Absolute Maximum Ratings

Stresses in excess of the absolute maximum ratings can permanently damage the device. Functional operation is not implied at these or any other conditions in excess of conditions represented in the operational sections of this data sheet. Exposure to absolute maximum ratings for extended periods may adversely affect device reliability.

**Table 2. Absolute Maximum Ratings**

| Parameter | Symbol | Ratings | Unit |
|---|---|---|---|
| Power Supply | $V_{CC}$ | 0 to 6 | V |
| Input Current | $I_{IN}$ | 100 | mA |
| Output Current | $I_{OUT}$ | 25 | mA |
| Storage Temperature | $T_{STR}$ | -55 to 125 | ºC |
| Soldering Temperature/Duration | $T_{PEAK}/t_P$ | 260 / 40 | ºC/sec |

## Reliability

The FX-702 is capable of meeting the following qualification tests:

**Table 3. Environmental Compliance**

| Parameter | Conditions |
|---|---|
| Mechanical Shock | MIL-STD-883, Method 2002 |
| Mechanical Vibration | MIL-STD-883, Method 2007 |
| Solderability | MIL-STD-883, Method 2003 |
| Gross and Fine Leak | MIL-STD-883, Method 1014 |
| Resistance to Solvents | MIL-STD-883, Method 2016 |
| Moisture Sensitivity Level Rating | MSL 1 |



## Handling Precautions

Although ESD protection circuitry has been designed into the the FX-702, proper precautions should be taken when handling and mounting. VI employs a Human Body Model (HBM) and a Charged Device Model (CDM) for ESD susceptibility testing and design protection evaluation. ESD thresholds are dependent on the circuit parameters used to define the model.

**Table 4. Predicted ESD R$atings**

| Model | Class | Minimum | Conditions |
|---|---|---|---|
| Human Body Model | 2 | 2000 V | MIL-STD 883, Method 3015 |
| Charged Device Model | C5 | 1000 V | JEDEC, JESD22-C101 |
| Machine Model | M3 | 200 V | ESD STM5.2-1999 |

| Table 5. Reflow Profile (IPC/JEDEC J-STD-020C) | | |
|---|---|---|
| Parameter | Symbol | Value |
| PreHeat Time | $t_S$ | 60 sec Min, 180 sec Max |
| Ramp Up | $R_{UP}$ | 3 ºC/sec Max |
| Time Above 217 ºC | $t_L$ | 60 sec Min, 150 sec Max |
| Time To Peak Temperature | $t_{AMB-P}$ | 480 sec Max |
| Time At 260 ºC | $t_P$ | 20 sec Min, 40 sec Max |
| Ramp Down | $R_{DN}$ | 6 ºC/sec Max |

The device has been qualified to meet the JEDEC standard for Pb-Free assembly. The temperatures and time intervals listed are based on the Pb-Free small body requirements. The temperatures refer to the topside of the package, measured on the package body surface. The FX-702 device is hermetically sealed so an aqueous wash is not an issue.

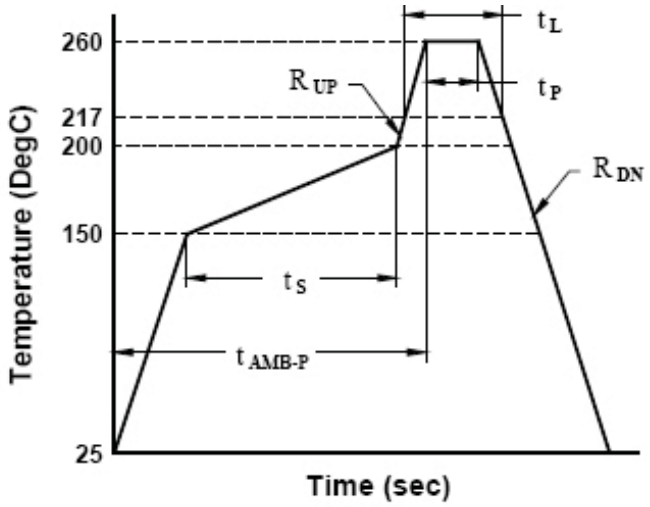


*Figure 3. Suggested IR Profile*

| Table 6. Tape and Reel Information | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Tape Dimensions (mm) | | | | | Reel Dimensions (mm) | | | | | | | |
| W | F | Do | Po | P1 | A | B | C | D | N | W1 | W2 | #/Reel |
| 16 | 7.5 | 1.5 | 4 | 8 | 178 | 1.5 | 13 | 20.2 | 50 | 16.4 | 22.4 | 200 |



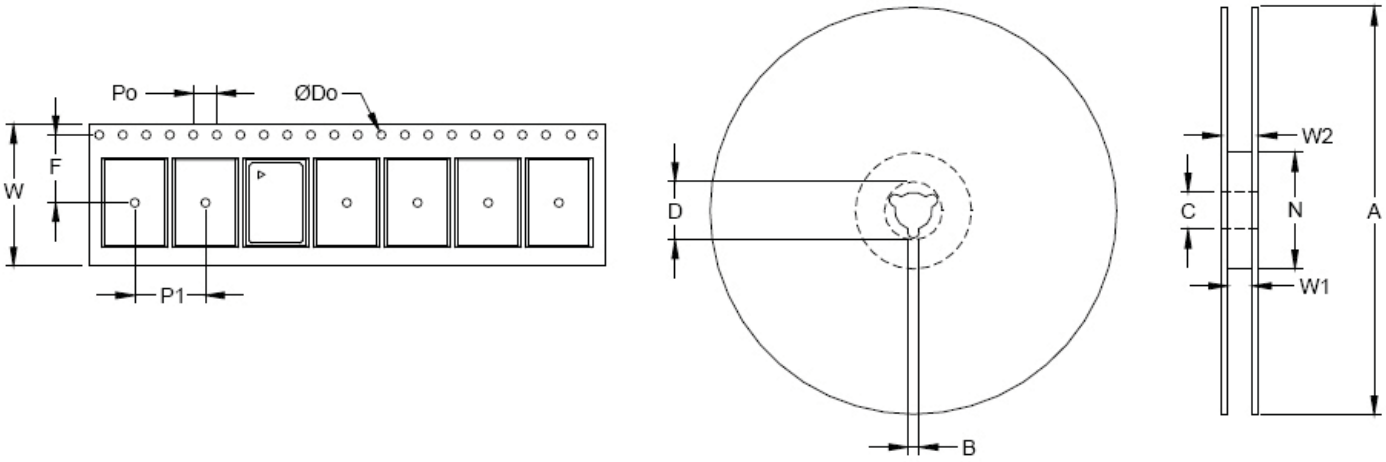


*Figure 4. Tape and Reel*

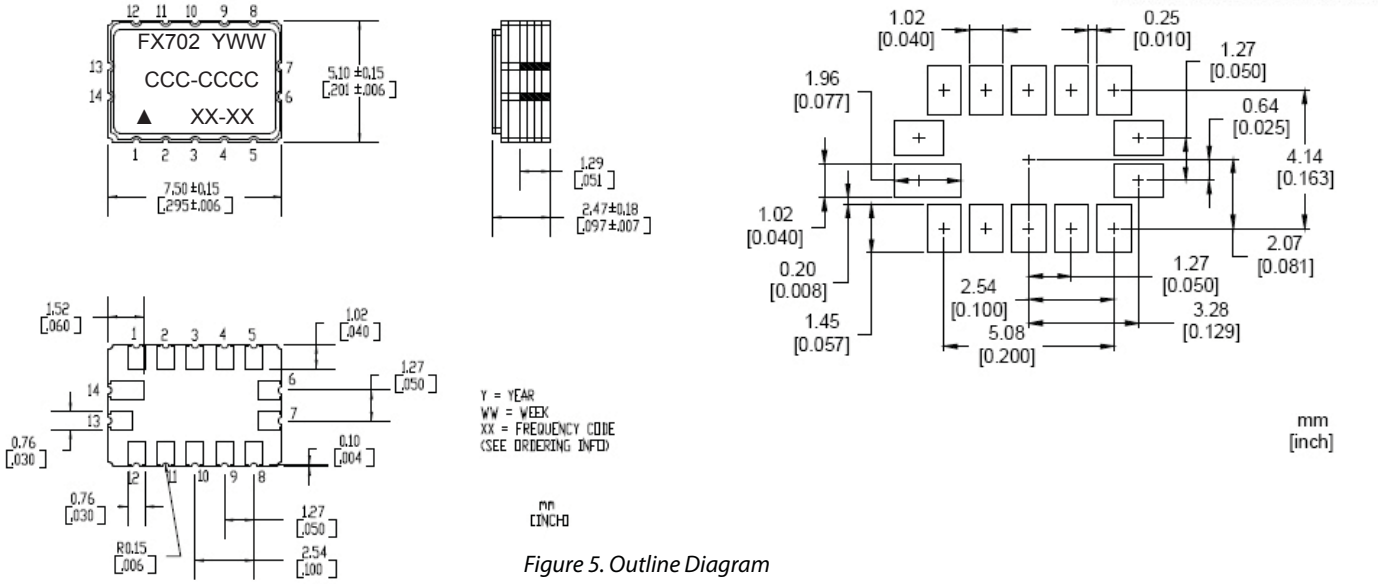


*Figure 5. Outline Diagram*

**Table 7. Pin Functions**

| Pad # | Symbol | I/O | Level | Function |
|---|---|---|---|---|
| 1 | BRCLK | I | NC or LVPE-CL, LVDS | NC or<br>For External divider application = PD Feedback Frequency |
| 2 | LD[1] | O | CMOS | Lock Detect<br>Logic 0 = FX Locked<br>Logic 1 - No Input<br>Output transitioning = Out of Lock |
| 3 | GND | GND | Supply | Case and electrical ground |
| 4 | MODE[2] | I | CMOS | FX Operating Mode<br>Logic 0 = Standard PLL (Normal Setting)<br>Logic 1 = FIN coupled to FOUT |
| 5 | GND | GND | Supply | Case and electrical ground |
| 6 | LFN | | Analog | Loop Filter Node |
| 7 | CLFN | | Analog | Complementary Loop Filter Node |
| 8 | FOUT | O | LVPECL or LVDS | Frequency Output |
| 9 | CFOUT | O | LVPECL or LVDS | Complementary Frequency Output |
| 10 | VCC | I | Supply | Power Supply Voltage (+3.3V ±5%) |
| 11 | CFIN | I | LVPECL | Complemetary Input Frequency<br>For CMOS inouts, AC-couple unused inputto ground or negative supply |
| 12 | FIN | I | CMOS or LVPECL | Input Frequency |
| 13 | GND | GND | Supply | Case and electrical ground |
| 14 | CBRCLK | I | NC or LVPE-CL, LVDS | NC or<br>For External divider applications = Comp. PD Feedback Frequency |



1. It is recommended that a buffer driver is used for best noise isolation.
2. Do not leave the MODE pin floating, it should be set to logic 0 or ground for normal operation.
3. BRCLK and CBRCLK should be left floating if not used.
4. FIN, CFIN, BRCLK, and CBRCLK have internal pull-up/pull-down resistors and it is recommended to AC couple these inputs.

## Table 8. Standard Frequencies (MHz)

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 18.7500000 | EE | 39.0625000 | HH | 73.7280000 | K8 | 173.437500 | NP | 624.693800 | PD | 796.875000 | TB |
| 19.2000000 | DD | 39.3216000 | HD | 74.1250000 | K1 | 176.838175 | NA | 624.704800 | P6 | 800.000000 | TK |
| 19.3926580 | DX | 39.8437500 | HJ | 74.1758000 | KA | 182.016000 | N8 | 625.000000 | P3 | 805.664100 | TA |
| 19.4400000 | D6 | 40.0000000 | JF | 74.2500000 | K7 | 182.857142 | NM | 627.329600 | P7 | 809.063500 | TE |
| 19.5312500 | DZ | 40.2830630 | KK | 75.0000000 | KH | 184.000000 | NG | 629.987800 | PA | 819.200000 | TH |
| 19.6608000 | DB | 40.9600000 | J1 | 76.8000000 | K4 | 184.320000 | NH | 637.500000 | PG | 821.777300 | TF |
| 19.6989680 | DK | 41.0888870 | KM | 77.7600000 | K2 | 187.500000 | N5 | 640.000000 | PN | 850.000000 | TJ |
| 19.7190000 | DH | 41.6571440 | KP | 78.0000000 | LH | 195.000000 | N7 | 644.531250 | P4 | 983.400000 | TU |
| 19.9218750 | ED | 41.6600000 | LM | 78.1250000 | K3 | 200.000000 | NE | 645.120000 | RJ | 1,000.0000 | TM |
| 20.0000000 | E2 | 41.8329130 | KT | 78.6432000 | K5 | 200.192000 | N6 | 647.239400 | PE | | |
| 20.1416000 | E3 | 42.0000000 | JB | 79.6875000 | KG | 201.416020 | N1 | 647.250800 | PK | | |
| 20.4800000 | E4 | 42.0101690 | KV | 80.0000000 | K9 | 212.500000 | NF | 649.970300 | PF | | |
| 20.5444340 | EF | 42.5000000 | JC | 80.5664130 | KJ | 219.429571 | NL | 657.421875 | PB | | |
| 20.7135000 | E1 | 42.6600000 | JZ | 82.1777380 | KL | 240.000000 | NR | 665.625600 | PC | | |
| 20.8285720 | EG | 44.2095440 | KX | 82.9440000 | K6 | 243.000000 | NC | 666.514286 | P5 | | |
| 20.8286000 | EB | 44.4343000 | LF | 83.3142880 | KN | 245.760000 | N9 | 669.128100 | R2 | | |
| 20.9165460 | EH | 44.6218000 | JW | 83.6658250 | KR | 250.000000 | NT | 669.326582 | R3 | | |
| 21.0050840 | EJ | 44.7360000 | J3 | 84.0203380 | KU | 252.571428 | NJ | 669.642900 | R1 | | |
| 22.0000000 | E9 | 44.9280000 | JE | 86.6853740 | LJ | 256.000000 | NK | 670.838600 | R7 | | |
| 22.1047720 | EK | 45.1584000 | JG | 88.4190880 | KW | 262.144000 | NB | 672.000000 | RT | | |
| 22.2171000 | E5 | 45.8240000 | JM | 95.7000000 | LK | 292.571429 | NN | 672.156250 | TX | | |
| 22.5792000 | E8 | 46.0379460 | LG | 97.5000000 | KE | 300.000000 | PT | 672.162712 | R5 | | |
| 24.0000000 | EC | 46.7200000 | JK | 100.000000 | L8 | 307.200000 | RX | 673.456600 | RA | | |
| 24.5760000 | E6 | 46.8750000 | JY | 105.000000 | L6 | 311.040000 | P1 | 684.255400 | R9 | | |
| 24.7040000 | E7 | 48.0000000 | JV | 106.250000 | L9 | 312.500000 | PU | 687.700000 | TV | | |
| 25.0000000 | F7 | 49.1520000 | J7 | 108.000000 | LA | 318.750000 | PV | 690.569196 | R4 | | |
| 25.1658000 | F8 | 49.4080000 | J2 | 110.000000 | L1 | 320.000000 | PP | 693.468750 | RV | | |
| 25.6000000 | F6 | 50.0000000 | JD | 112.000000 | L2 | 322.265650 | PW | 693.482991 | R6 | | |
| 25.9200000 | F2 | 50.0480000 | KD | 114.000000 | L3 | 328.710950 | PX | 693.750000 | R8 | | |
| 26.0000000 | F3 | 51.2000000 | LL | 120.000000 | LC | 333.257150 | PY | 696.390625 | RW | | |
| 27.0000000 | F4 | 51.8400000 | J4 | 122.880000 | LB | 334.663300 | RB | 696.421478 | V1 | | |
| 27.6480000 | FB | 52.0000000 | JP | 124.416000 | L7 | 336.081350 | RC | 696.421875 | TY | | |
| 28.7040000 | F1 | 53.3300000 | JU | 125.000000 | L4 | 353.676350 | RD | 704.380600 | TG | | |
| 29.4912000 | F5 | 54.7460000 | JL | 130.000000 | LD | 368.640000 | RY | 707.352700 | TC | | |
| 29.5000000 | F9 | 55.0000000 | JX | 139.264000 | L5 | 375.000000 | RF | 707.500000 | V2 | | |
| 30.0000000 | HE | 60.0000000 | JR | 150.000000 | M8 | 382.800000 | RU | 710.948600 | T2 | | |
| 30.7200000 | H1 | 61.3800000 | KY | 150.144000 | M6 | 400.000000 | RR | 712.520000 | TW | | |
| 30.8800000 | HF | 61.4400000 | J5 | 153.600000 | MA | 409.600000 | RE | 716.573200 | T1 | | |
| 31.2500000 | H8 | 62.2080000 | J8 | 155.520000 | M2 | 491.520000 | PM | 718.750000 | T5 | | |
| 32.0000000 | H2 | 62.5000000 | J9 | 156.250000 | M3 | 500.000000 | RK | 719.734400 | T3 | | |
| 32.7680000 | H3 | 62.9145000 | LE | 159.375000 | M7 | 505.000000 | V3 | 737.280000 | TL | | |
| 33.0000000 | H7 | 63.3600000 | JJ | 160.000000 | M1 | 531.000000 | PH | 739.200000 | TT | | |
| 33.3330000 | HC | 63.8976000 | JN | 161.132813 | M4 | 531.250000 | P8 | 742.500000 | V4 | | |
| 34.3680000 | H6 | 64.0000000 | JT | 164.355475 | M9 | 568.928600 | PJ | 748.070900 | T6 | | |
| 34.5600000 | HB | 64.1520000 | JH | 166.628572 | M5 | 569.196400 | P9 | 750.000000 | T7 | | |
| 36.8640000 | HG | 65.5360000 | J6 | 167.331646 | N2 | 588.000000 | RH | 768.000000 | TN | | |
| 37.0560000 | H4 | 66.0000000 | JA | 168.040678 | N3 | 595.056000 | PL | 777.600000 | T4 | | |
| 37.1250000 | H9 | 70.0000000 | KB | 170.000000 | N4 | 600.000000 | PR | 779.568600 | T8 | | |
| 37.5000000 | HK | 70.6560000 | KC | 172.500000 | NU | 614.400000 | RG | 780.881000 | TD | | |
| 38.8800000 | H5 | 71.6100000 | KF | 173.370748 | ND | 622.080000 | P2 | 781.250000 | T9 | | |

# Ordering Information

**FX- 702 - E C E - H J K A - XX - XX**

**Product Family**
FX: Frequency Translator

**Package**
702: 5.0 x 7.5 x 2.0mm

**Input**
E: 3.3 Vdc ±10%

**Output**
C: LVPECL
D: LVDS

**Operating Temperature**
E: -40 to 85 °C
T: 0 to 70 °C

**Absolute Pull Range**
H: ± 32 ppm
K: ± 50 ppm
S: ± 100 ppm

**Feedback Divider**
L: Disable
M: Factory Set

**Output 2 Divider**
M: Factory Set

**Prescaler**
A: 1
C: **4**
**M: Factory Set**

**Input Frequency (See Above)**

**Output Frequency (See Above)**

*1, Not all combinations are possible. Please consult with your Vectron representative for application assistance. Other frequencies available upon request*
*2, When ordering the FX-702 with the external divider option, the prescalar must be specified (i.e, 1 or 4). The "XX" place holder should be used for the input frequency.*



## For Additional Information, Please Contact


***USA:***
Vectron International
267 Lowell Road
Hudson, NH 03051
Tel: 1.888.328.7661
Fax: 1.888.329.8328

***Europe:***
Vectron International
Landstrasse, D-74924
Neckarbischofsheim, Germany
Tel: +49 (0) 3328.4784.17
Fax: +49 (0) 3328.4784.30

***Asia:***
Vectron International
1F-2F, No 8 Workshop, No 308 Fenju Road
WaiGaoQiao Free Trade Zone
Pudong, Shanghai, China 200131
Tel: 86.21.5048.0777
Fax: 86.21.5048.1881