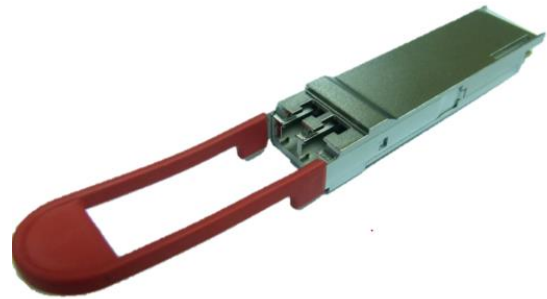


## **40Gb/S QSFP+ ER4 Transceiver**

**P/N: TQSFPP-CC1IAAA**



### **Product Features**

- Compliant with IEEE 802.3ba 40G BASE-ER4 standards
- QSFP+ MSA compliant
- Up to 11.2Gb/s data rate per channel
- Up to 40km transmission on single mode fiber
- Maximum power consumption 3.5W
- 18.5dB link insertion loss budget
- 4 CWDM lanes MUX/DEMUX design
- Single 3.3V power supply
- 0°C to 70°C case temperature operating range
- LC duplex connector
- Up to 40km reach over standard single mode fiber
- I2C management interface
- RoHS-6 Compliant

### **Application**

- Ethernet for 40GBASE-ER4
- InfiniBand DDR & QDR
- Client-side 40G Telecom connections

## Absolute Maximum Rating

| Parameter                   | Min  | Max | Unit | Note |
|-----------------------------|------|-----|------|------|
| Storage Temperature         | -40  | 85  | °C   |      |
| 3.3V Power Supply Voltage   | -0.5 | 3.6 | V    |      |
| Relative Humidity           | 0    | 85  | %    |      |
| Damage Threshold, each Lane | 3.8  |     | dBm  |      |

## Recommended Operating Conditions

| Parameter                  | Min   | Typical | Max             | Unit | Note |
|----------------------------|-------|---------|-----------------|------|------|
| Case Operating Temperature | 0     |         | 70              | °C   |      |
| Power Supply Voltage       | 3.135 | 3.3     | 3.465           | V    |      |
| Data Rate per Channel      |       | 10.3125 | 11.2            | Gbps |      |
| Control Input Voltage High | 2     |         | V <sub>cc</sub> | V    |      |
| Control Input Voltage Low  | 0     |         | 0.8             | V    |      |
| Link Distance with G.652   |       |         | 40              | km   |      |

## Electrical Characteristics

| Parameter                                     | Min  | Typical | Max  | Unit             | Note                          |
|-----------------------------------------------|------|---------|------|------------------|-------------------------------|
| <b>Transceiver Electrical Characteristics</b> |      |         |      |                  |                               |
| TRx Power Consumption                         |      |         | 3.5  | W                |                               |
| Supply Current                                |      |         | 1.1  | A                |                               |
| Transceiver Power-on Initialization Time      |      |         | 2000 | ms               | 1                             |
| <b>Transmitter (each Lane)</b>                |      |         |      |                  |                               |
| Single-ended Input Voltage Tolerance (Note 2) | -0.3 |         | 4    | V                | Referred to TP1 signal common |
| AC Common Mode Input Voltage Tolerance        | 15   |         |      | mV               | RMS                           |
| Differential Input Voltage Swing Threshold    | 50   |         |      | mV <sub>pp</sub> | LOSA Threshold                |
| Differential Input Voltage Swing              | 190  |         | 700  | mV <sub>pp</sub> |                               |
| Differential Input Impedance                  | 90   | 100     | 110  | Ohm              |                               |

|                                                         |                            |     |      |       |                              |
|---------------------------------------------------------|----------------------------|-----|------|-------|------------------------------|
| Differential Input Return Loss                          | See IEEE 802.3ba 86A.4.11  |     |      | dB    | 10MHz-11.1GHz                |
| J2 Jitter Tolerance                                     | 0.17                       |     |      | UI    |                              |
| J9 Jitter Tolerance                                     | 0.29                       |     |      | UI    |                              |
| Data Dependent Pulse Width Shrinkage (DDPWS ) Tolerance | 0.07                       |     |      | UI    |                              |
| Eye Mask Coordinates {X1,X2,Y1,Y2}                      | {0.11,0.31,95,350}         |     |      | UI mV | Hit Ratio=5x10 <sup>-5</sup> |
| Receiver (each Lane)                                    |                            |     |      |       |                              |
| Single-ended Output Voltage                             | -0.3                       |     | 4.0  | V     | Referred to signal common    |
| AC Common Mode Output Voltage                           |                            |     | 7.5  | mV    | RMS                          |
| Differential Output Voltage Swing                       | 300                        |     | 850  | mVpp  |                              |
| Differential Output Impedance                           | 90                         | 100 | 110  | Ohm   |                              |
| Termination Mismatch at 1MHz                            |                            |     | 5    | %     |                              |
| Differential Output Return Loss                         | See IEEE 802.3ba 86A.4.2.1 |     |      | dB    | 10MHz-11.1GHz                |
| Common Mode Output Return Loss                          | See IEEE 802.3ba 86A.4.2.2 |     |      | dB    | 10MHz-11.1GHz                |
| Output Transition Time                                  | 28                         |     |      | ps    | 20% to 80%                   |
| J2 Jitter Output                                        |                            |     | 0.42 | UI    |                              |
| J9 Jitter Output                                        |                            |     | 0.65 | UI    |                              |
| Eye Mask Coordinates {X1,X2,Y1,Y2}                      | {0.29,0.5,150,425}         |     |      | UI mV | Hit Ratio=5x10 <sup>-5</sup> |

### Notes:

1. Power-on Initialization Time is the time from when the power supply voltages reach and remain above the minimum recommended operating supply voltages to the time when the module is fully functional.
2. The single ended input voltage tolerance is the allowable range of the instantaneous input signals.

## Optical Characteristics

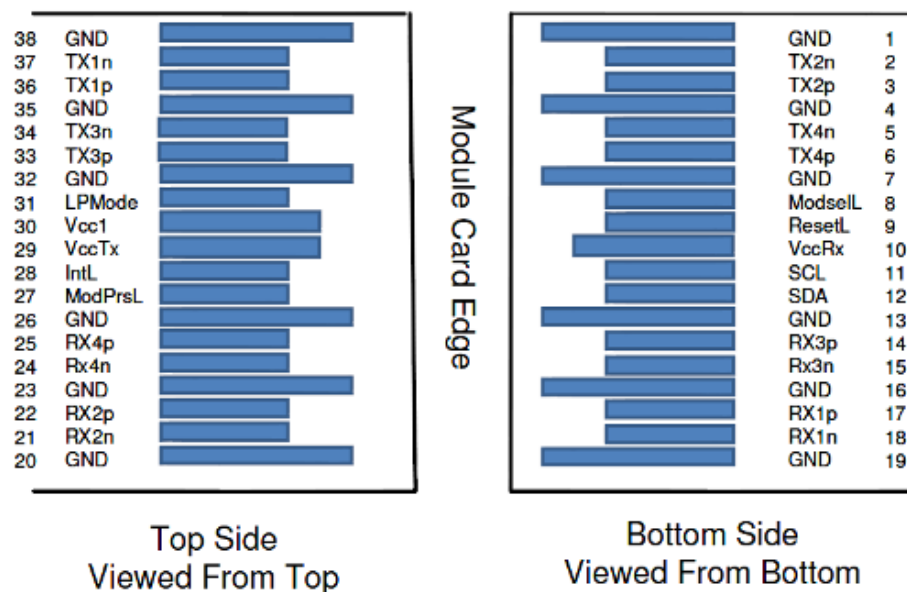
| Parameter                                                                     | Symbol         | Min                                | Typical | Max    | Unit  | Note            |
|-------------------------------------------------------------------------------|----------------|------------------------------------|---------|--------|-------|-----------------|
| Lane Wavelength                                                               | L0             | 1264.5                             | 1271    | 1277.5 | nm    |                 |
|                                                                               | L1             | 1284.5                             | 1291    | 1297.5 | nm    |                 |
|                                                                               | L2             | 1304.5                             | 1311    | 1317.5 | nm    |                 |
|                                                                               | L3             | 1324.5                             | 1331    | 1337.5 | nm    |                 |
| <b>Transmitter Optical Characteristics</b>                                    |                |                                    |         |        |       |                 |
| Side Mode Suppression Ratio                                                   | SMSR           | 30                                 |         |        | dB    |                 |
| Total Average Launch Power                                                    | PT             |                                    |         | 10.5   | dBm   |                 |
| Average Launch Optical Power, each lane                                       | LOP            | -2.7                               |         | 4.5    | dBm   |                 |
| Optical Modulation Amplitude, each lane                                       | OMA            | 0.3                                |         | 5.0    | dBm   | 1               |
| Difference in Launch Power between any Two Lanes (OMA)                        | Ptx,diff       |                                    |         | 4.7    | dB    |                 |
| Launch Power in OMA minus Transmitter and Dispersion Penalty (TPD), each Lane |                | -0.5                               |         |        | dBm   |                 |
| TDP, each lane                                                                | TDP            |                                    |         | 2.6    | dB    |                 |
| Average launch power of OFF transmitter, each lane                            | Poff           |                                    |         | -30    | dBm   |                 |
| Extinction Ratio                                                              | ER             | 5.5                                |         |        | dB    |                 |
| Relative Intensity Noise                                                      | RIN            |                                    |         | -128   | dB/Hz | 12dB reflection |
| Optical Return Loss Tolerance                                                 | TOL            |                                    |         | 20     | dB    |                 |
| Transmitter Reflectance                                                       | R <sub>T</sub> |                                    |         | -12    | dB    |                 |
| Eye Mask<br>{X1, X2, X3, Y1, Y2, Y3}                                          |                | {0.25, 0.4, 0.45, 0.25, 0.28, 0.4} |         |        |       |                 |
| Average Launch Power OFF Transmitter, each Lane                               |                |                                    |         | -30    | dBm   |                 |
| <b>Receiver Optical Characteristics</b>                                       |                |                                    |         |        |       |                 |
| Damage Threshold, each Lane                                                   | THd            | 3.8                                |         |        | dBm   | 2               |
| Average Receive Power, each Lane                                              |                | -21.2                              |         | -4.5   | dBm   |                 |

|                                                                 |      |     |      |       |     |   |
|-----------------------------------------------------------------|------|-----|------|-------|-----|---|
| Receiver Reflectance                                            |      |     |      | -26   | dB  |   |
| Receive Power (OMA), each Lane                                  |      |     |      | -4    | dBm |   |
| Difference in Receive Power between any Two Lanes (OMA)         |      |     |      | 7     | dB  |   |
| Receiver Sensitivity (OMA), each Lane                           | SEN  |     |      | -19   | dBm |   |
| Stressed Receiver Sensitivity (OMA), each Lane                  |      |     |      | -16.8 | dBm | 3 |
| LOS Assert                                                      | LosA | -35 |      |       | dBm |   |
| LOS Deassert                                                    | LosD |     |      | -20   | dBm |   |
| LOS Hysteresis                                                  | LosH | 0.5 |      |       | dB  |   |
| Receiver Electrical 3dB upper Cutoff Frequency, each Lane       | Fc   |     |      | 12.3  | GHz |   |
| <b>Conditions of stressed receiver sensitivity test(Note4):</b> |      |     |      |       |     |   |
| Vertical Eye Closure Penalty, each Lane                         |      |     | 2.2  |       | dB  |   |
| Stressed eye J2 Jitter                                          |      |     | 0.3  |       | UI  |   |
| Stressed eye J9 Jitter                                          |      |     | 0.47 |       | UI  |   |

### Notes:

1. Even if the TDP < 0.8 dB, the OMA min must exceed the minimum value specified here.
2. The receiver shall be able to tolerate, without damage, continuous exposure to a modulated optical input signal having this power level on one lane. The receiver does not have to operate correctly at this input power.
3. Measured with conformance test signal at receiver input for BER =  $1 \times 10^{-12}$
4. Vertical eye closure penalty and stressed eye jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

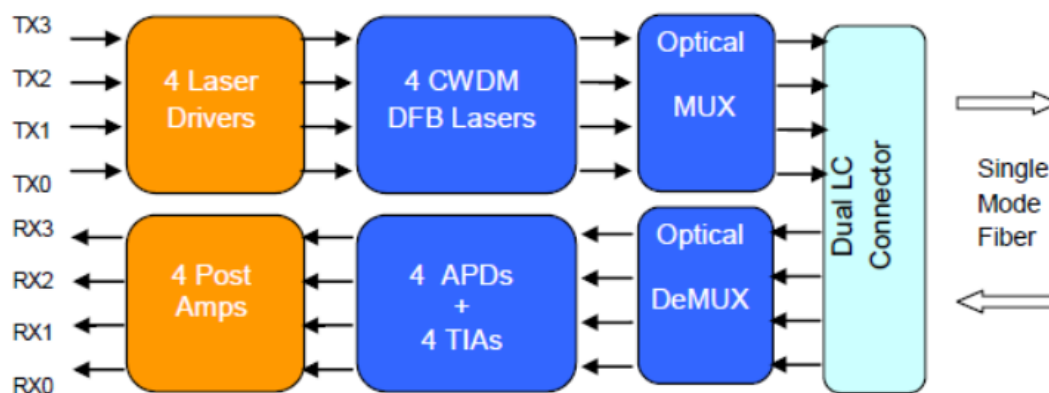
## QSFP+ Module Pad Assignments and Descriptions



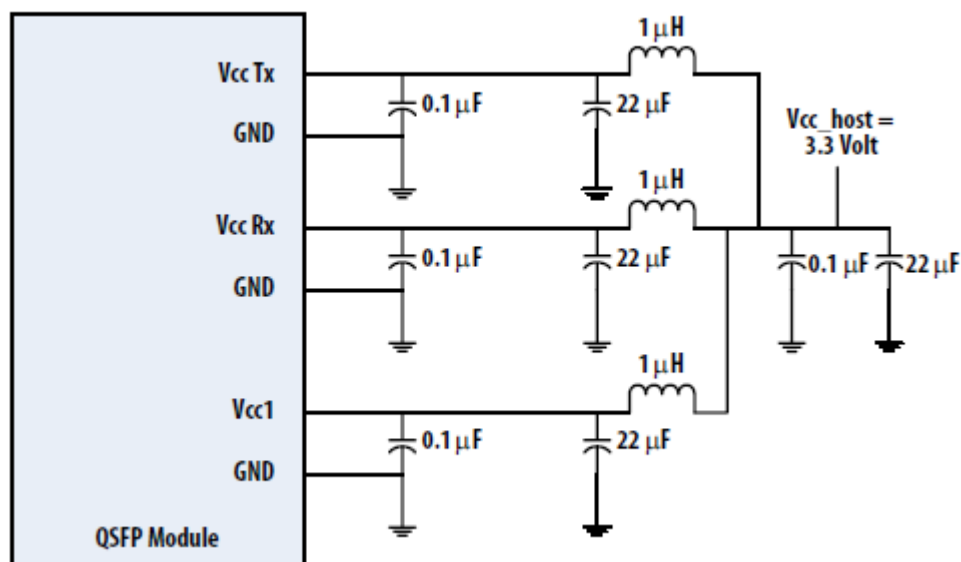
| Pin | Logic       | Symbol  | Description                         | Plug Sequence | Notes |
|-----|-------------|---------|-------------------------------------|---------------|-------|
| 1   |             | GND     | Ground                              | 1             |       |
| 2   | CML-I       | Tx2n    | Transmitter Inverted Data Input     | 3             |       |
| 3   | CML-I       | Tx2p    | Transmitter Non-Inverted Data Input | 3             |       |
| 4   |             | GND     | Ground                              | 1             |       |
| 5   | CML-I       | Tx4n    | Transmitter Inverted Data Input     | 3             |       |
| 6   | CML-I       | Tx4p    | Transmitter Non-Inverted Data Input | 3             |       |
| 7   |             | GND     | Ground                              | 1             |       |
| 8   | LVTTL-I     | ModSelL | Module Select                       | 3             |       |
| 9   | LVTTL-I     | ResetL  | Module Reset                        | 3             |       |
| 10  |             | Vcc Rx  | +3.3V Power Supply Receiver         | 2             |       |
| 11  | LVC MOS-I/O | SCL     | 2-wire serial interface clock       | 3             |       |
| 12  | LVC MOS-I/O | SDA     | 2-wire serial interface data        | 3             |       |
| 13  |             | GND     | Ground                              | 1             |       |
| 14  | CML-O       | Rx3p    | Receiver Non-Inverted Data Output   | 3             |       |
| 15  | CML-O       | Rx3n    | Receiver Inverted Data Output       | 3             |       |
| 16  |             | GND     | Ground                              | 1             |       |
| 17  | CML-O       | Rx1p    | Receiver Non-Inverted Data Output   | 3             |       |
| 18  | CML-O       | Rx1n    | Receiver Inverted Data Output       | 3             |       |

|    |         |         |                                     |   |  |
|----|---------|---------|-------------------------------------|---|--|
| 19 |         | GND     | Ground                              | 1 |  |
| 20 |         | GND     | Ground                              | 1 |  |
| 21 | CML-O   | Rx2n    | Receiver Inverted Data Output       | 3 |  |
| 22 | CML-O   | Rx2p    | Receiver Non-Inverted Data Output   | 3 |  |
| 23 |         | GND     | Ground                              | 1 |  |
| 24 | CML-O   | Rx4n    | Receiver Inverted Data Output       | 3 |  |
| 25 | CML-O   | Rx4p    | Receiver Non-Inverted Data Output   | 3 |  |
| 26 |         | GND     | Ground                              | 1 |  |
| 27 | LVTTL-O | ModPrsL | Module Present                      | 3 |  |
| 28 | LVTTL-O | IntL    | Interrupt                           | 3 |  |
| 29 |         | Vcc Tx  | +3.3V Power supply transmitter      | 2 |  |
| 30 |         | Vcc1    | +3.3V Power supply                  | 2 |  |
| 31 | LVTTL-I | LPMode  | Low Power Mode                      | 3 |  |
| 32 |         | GND     | Ground                              | 1 |  |
| 33 | CML-I   | Tx3p    | Transmitter Non-Inverted Data Input | 3 |  |
| 34 | CML-I   | Tx3n    | Transmitter Inverted Data Input     | 3 |  |
| 35 |         | GND     | Ground                              | 1 |  |
| 36 | CML-I   | Tx1p    | Transmitter Non-Inverted Data Input | 3 |  |
| 37 | CML-I   | Tx1n    | Transmitter Inverted Data Input     | 3 |  |
| 38 |         | GND     | Ground                              | 1 |  |

## Transceiver Block Diagram

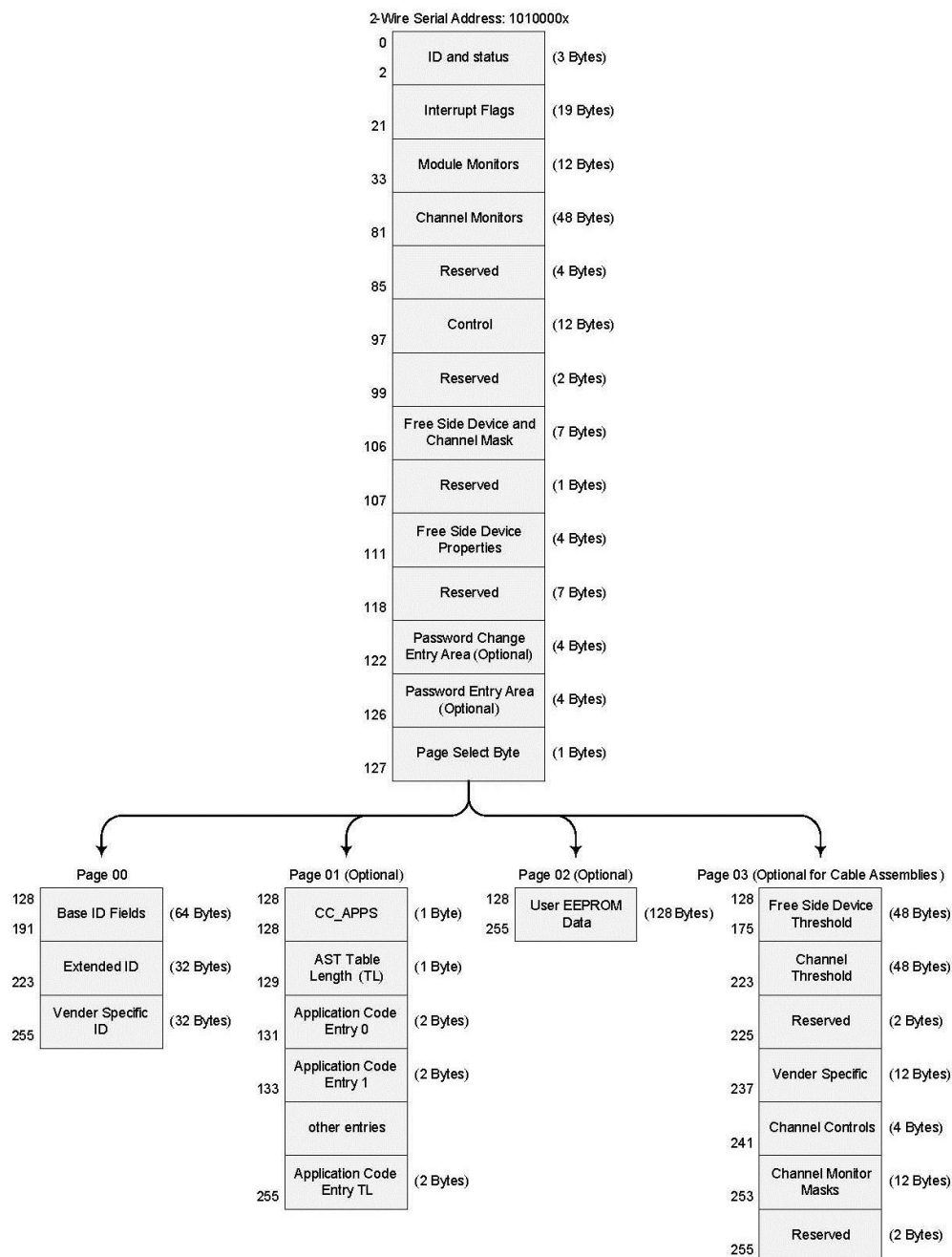


## Recommended Host Board Power Supply Circuit



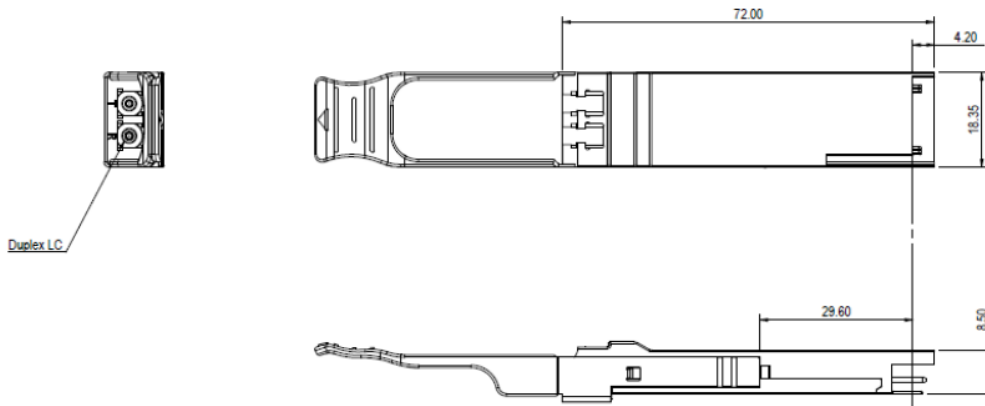
## Memory Map

The memory map is structured as a single address and multiple page approaches, according to the QSFP+ SFF-8436 MSA specification as shown in the below. For more detailed description of this memory map or lower pages, please see our Memory Map document with flexible customization settings.



## Mechanical Design Diagram

Unit: mm



## ESD

This transceiver is specified as ESD threshold 1kV for high speed data pins and 2kV for all others electrical input pins, tested per MIL-STD-883, Method 3015.4 /JESD22-A114-A (HBM). However, normal ESD precautions are still required during the handling of this module. This transceiver is shipped in ESD protective packaging. It should be removed from the packaging and handled only in an ESD protected environment.

## Laser Safety

This is a Class 1 Laser Product according to EN 60825-1:2014. This product complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated (June 24, 2007).