1 Scope:

This document is a design guide to provide a means of reducing the power drain for an RFID reader based on the MLX 90121. In some applications, such as hand held readers, the maximum reading range may not be of paramount importance while the operating life of the battery is much more critical.

2 Application schematic:

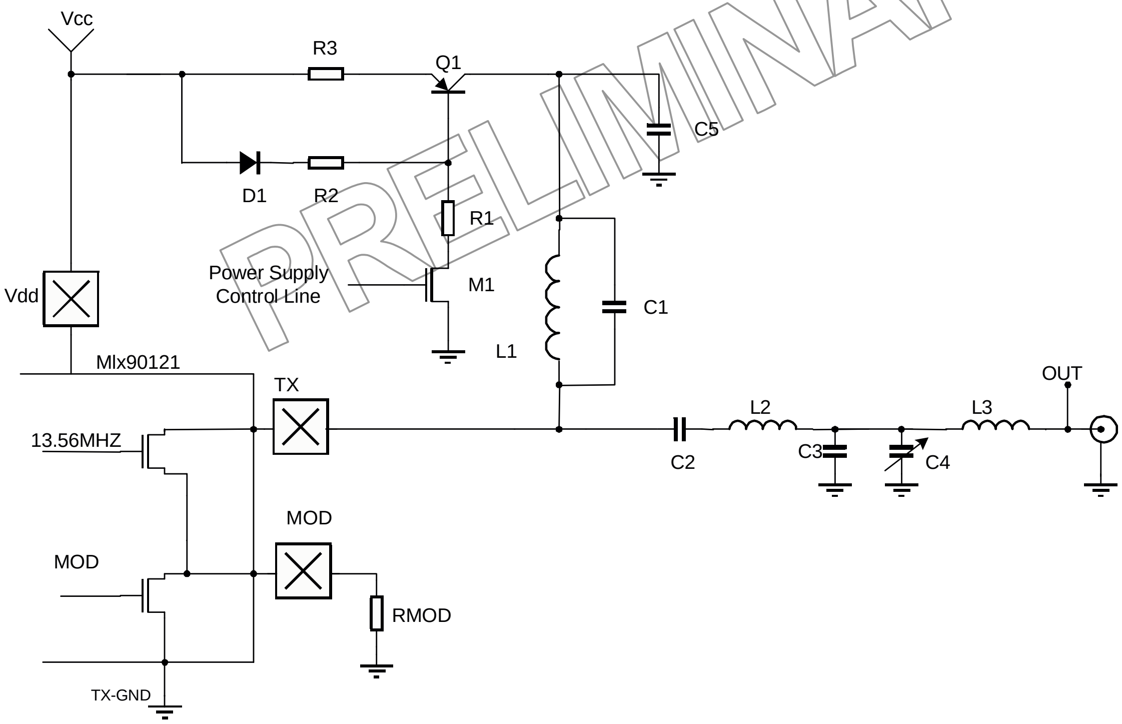

Figure 1

2.1 Recommended Components:

Reference	Value	Comments
R1	See text	5% or better
R2	See text	5% or better
R3	See text	1% or better
M1	FDV301N	FAIRCHILD
Q1	FZT 949	ZETEX
D1	1N4148 or equivalent	
C5	4.7 µF	See notes

Notes: Other components values do not differ from the standard recommended reader schematic.
C5 should have a very low ESR. Recommended type is AVX TPSD475K050R0300

Presto Electronic Components Limited, Freemantle House, Kingsclere Park, Kingsclere, Newbury, Berkshire, RG20 4SW. United Kingdom
☎ +44 (0) 1635 291390 🗎 +44 (0) 1635 291391 ✉ info@presto.co.uk 💻 http://www.presto.co.uk
Registered in England and Wales No. 4396767 V.A.T No. GB. 784 1084 21

2.2 Theory of operation and design guidelines:

Please refer to figure 1. When transistor M1 is switched on, Q1 is switched on as a consequence and the output transistor of the MLX90121 is energized as well. D1, R2, R3, R1 constitute a current limiter. One can approximate the current limit of Q1 with the following formula:

$$IC_{Q1} \approx \frac{(V_{cc} - VF_{D1}) \cdot R_2}{R_3 \cdot (R_1 + R_2)}$$

Where VF_{D1} is the forward voltage drop of the diode D1.

In this approximation, the base current of Q1 is neglected. Therefore, it will be more accurate if one selects relatively small values for R1 and R2. But, in doing so, the overall current drain will increase, and one will have to make proper trade-off. Another issue is that the actual voltage drop of D1 should be measured for the current supposed to flow through it. The standard value of 0.7 Volts @27°C may not be correct in this application.

To set a given value for IC_{Q1}, one can use the following formula, after the values of R3 and R2 have been selected:

$$R_1 = \frac{(V_{cc} - VF_{D1}) \cdot R_2 - IC_{Q1} \cdot R_3 \cdot R_2}{IC_{Q1} \cdot R_3}$$

The current limitation of Q1 will limit the DC current that the MLX9012 can take. This will have as effect that the voltage on C5 will drop to a value such that the MLX90121 output stage will not take more average DC current than Q1 supplies.

In case one would like to use different power settings that are microcontroller settable, one may use the schematic as depicted in figure 2. Using the control lines Control1 and Control2 the two MOS transistors M1 and M2 will switch on either resistor R1 or R4 or the combination of both. These combinations allow for three different power level settings.

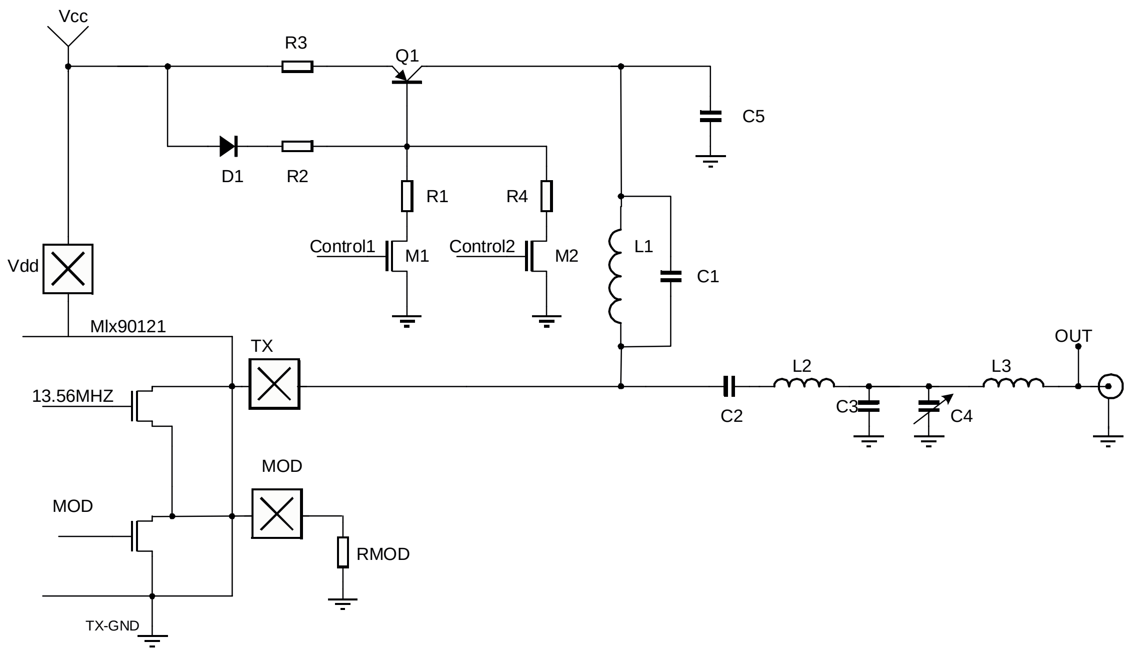

Figure 2

Presto Electronic Components Limited, Freemantle House, Kingsclere Park, Kingsclere, Newbury, Berkshire, RG20 4SW. United Kingdom
☎ +44 (0) 1635 291390 🖹 +44 (0) 1635 291391 ✉ info@presto.co.uk 💻 http://www.presto.co.uk
Registered in England and Wales No. 4396767 V.A.T No. GB. 784 1084 21

3 Measured values for a typical application:

The following configuration was used to make these measurements:

Vcc = 3 Volts

R2 = 330 ohms

R3 = 10 ohms

Antenna: standard Melexis antenna 12 cm x 12 cm.

Tag and protocol: ISO 15693 FSK / double sub carrier.

R1 was implemented as a 10 K ohms 25 turns potentiometer.

IC_{Q1} mA	Power stage DC voltage Vc5 Volts	Power stage Consumption mW	Antenna power mW	Power Efficiency %	Measured value for R1	Reading distance cm
45	2.44	135	60	44	Below 350 ohms.	17
40	2.4	120	53	44	3.4 K ohms	16
30	1.66	90	30	30	5 K ohms	14.5
20	1.2	60	16	27	6.7 K ohms	13

Table 1

Note:
1) The reading distance was measured with a ISO15693 FSK / double subcarrier tag and is given for reference only
2) The antenna power was measured by substituting a 50 ohms load to the antenna. The capacitance of a standard oscilloscope probe would otherwise change the tuning of the reader matching network and hence destroy the measurement accuracy.

As one can see from table 1 the voltage at C5 drops from 3V to 2.44V when the current is limited to 45mA and to as low as 1.2V when the current is limited to 20mA. The antenna power drops from 60mW to 16mW, and because of the larger voltage drop in Q1 the efficiency of the whole circuit drops from 44% to 27%. Reducing the antenna power from 60mW to 16mW does not decrease a lot the reading distance. In principle the reading distance is reduced to half for an eight-fold decrease in power.

Presto Electronic Components Limited, Freemantle House, Kingsclere Park, Kingsclere, Newbury, Berkshire, RG20 4SW. United Kingdom
☎ +44 (0) 1635 291390 🗎 +44 (0) 1635 291391 ✉ info@presto.co.uk 💻 http://www.presto.co.uk
Registered in England and Wales No. 4396767 V.A.T No. GB. 784 1084 21