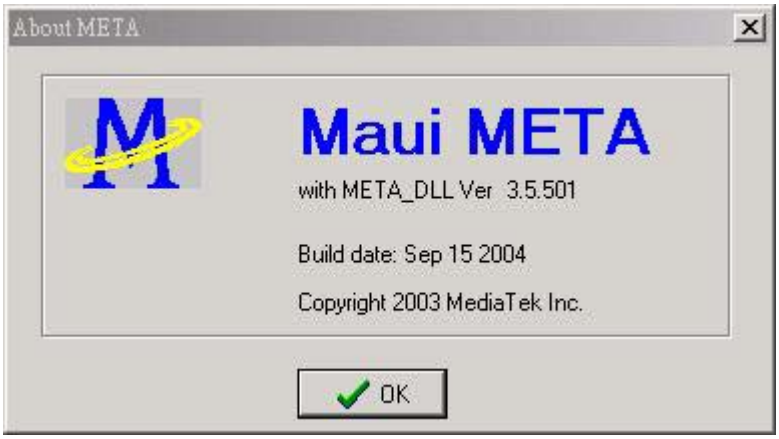

Figure 8 META dll version

3.2 RF tool

After META opens COM port, reads NVRAM database and reset target to test mode, user can start to do all calibration and testing. User can switch to RF tool by selecting [RF tool] from main selection menu.

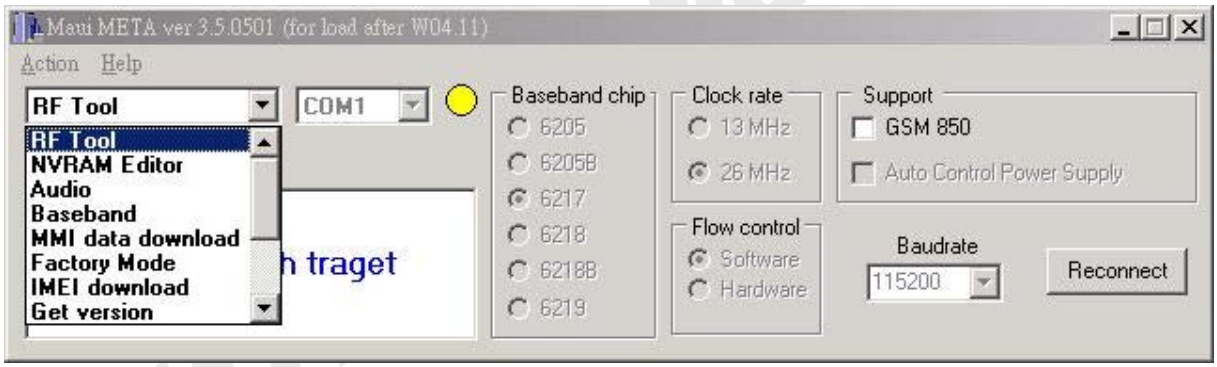

Figure 9 Select [RF Tool] from main selection menu

3.2.1 PM (power measurement)

PM function is used for measuring the power of the indicated channel. User can key in ARFCN, PM/Frame, PM Count and Gain (dB) and then click [Start] button. We can get the deviation from the formula below.

$$Variation(PM) = \frac{\sum_{n=1}^{N}(PM_i - \overline{PM})^2}{N} = \overline{PM^2} - (\overline{PM})^2 = (\frac{\sum_{n=1}^{N} PM_i^2}{N}) - (\frac{\sum_{n=1}^{N} PM_i}{N})^2,$$

$Deviation(PM) = \sqrt{Variation(PM)}$, where N = total measured samples = Testing FN * (Samples per frame)

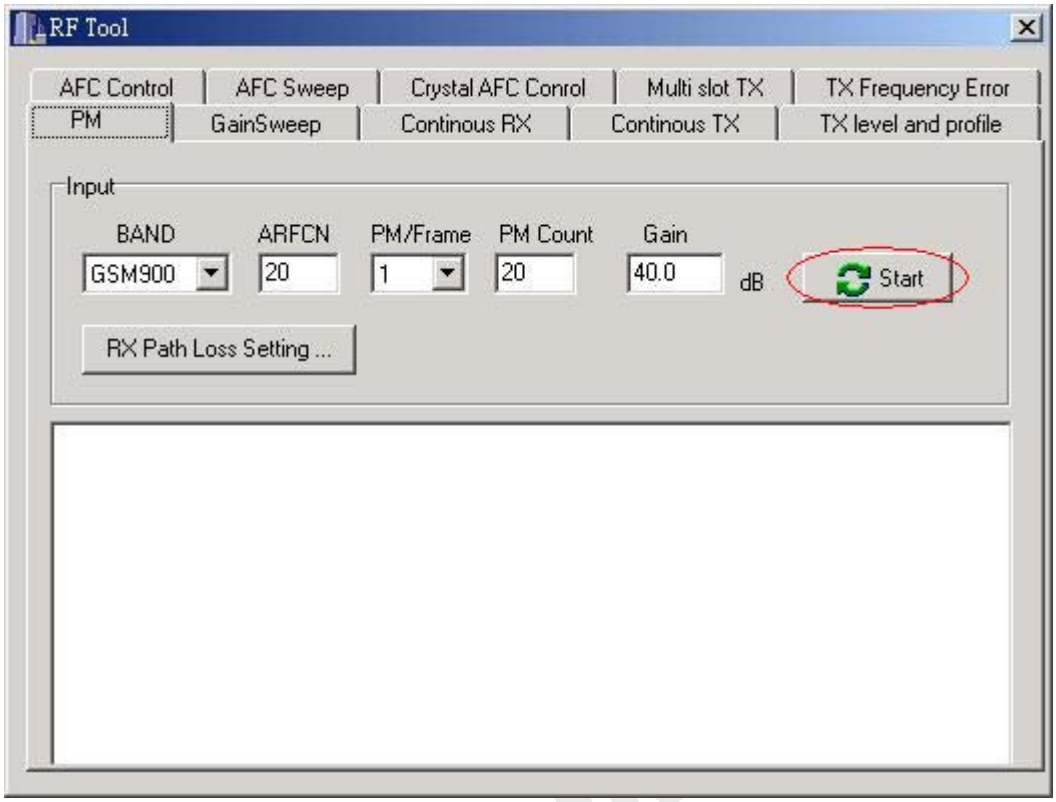

Figure 10 Click [Start] button to start power measurement

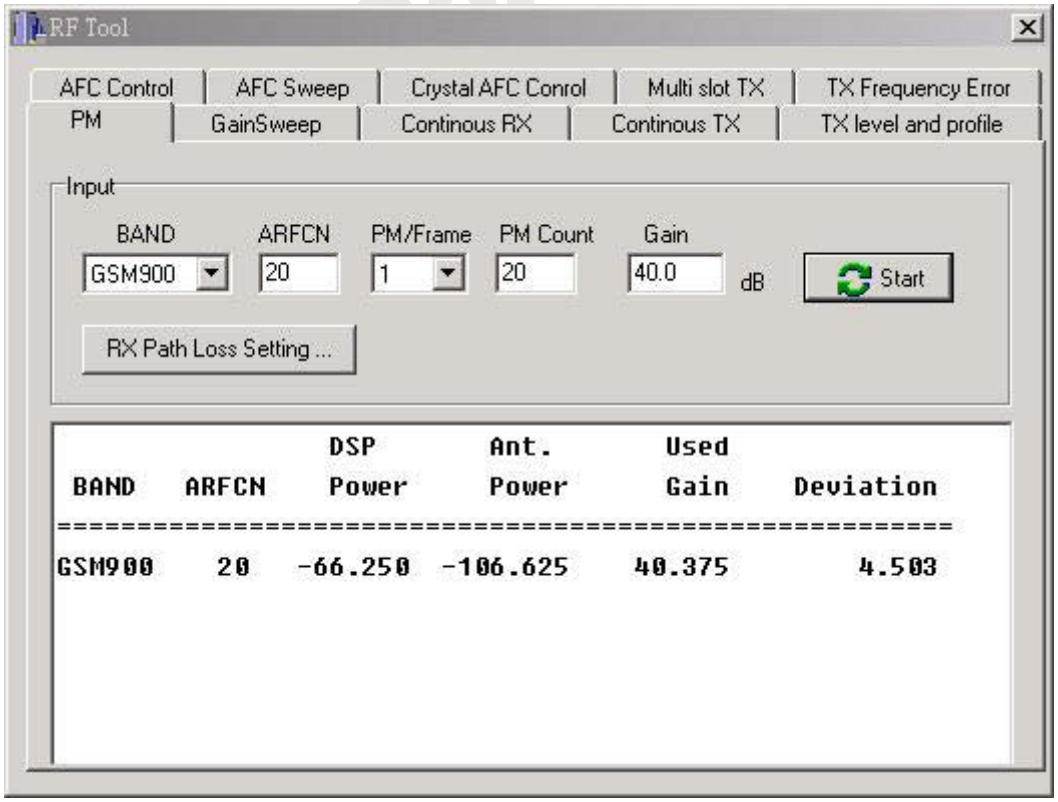

Figure 11 PM result

- DSP power (dBm) : It is the average of power measurement samples at DSP.

- Antenna power (dBm) : It is the average of the power measurement samples at antenna.
- Deviation : It is the deviation value of power measurement samples.
  - Note the value returned from target is square of deviation. PC side program will get deviation from root square of the value returned from target.
- Used Gain (dB) : It is gain of the entire RF module to measure input power.
  - Note the used gain returned may not equal the gain requested since the 2 dB quantization error from PGA of transceiver.

The difference of the downlink cell power and the average power of power measurement done by MS is the RX loss. User can save to flash or file by clicking [RX Path Loss Setting] button. Please refer to section 3.2.1.1.

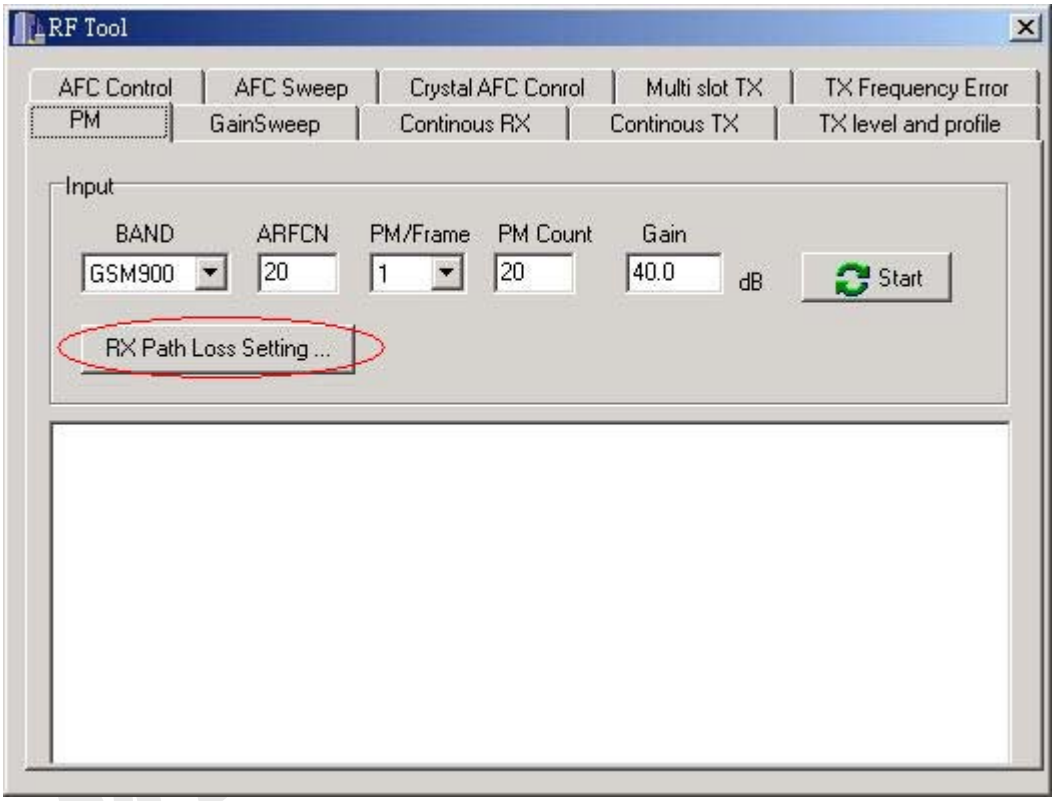

Figure 12 Click [RX Path Loss Setting] button

3.2.1.1 Sub band and path loss window

User can upload or download sub band and path loss values from or to flash. User can load and save these values to files in PC, too. The RX path loss stored in flash of MS will compensate the difference of the downlink cell power and the average power of measurement by RF module.

User can set RX path loss for each band. If the max ARFCN of the (N-1)th and Nth are A, B and the Nth RX loss is C dB, that means MS will set the RX path loss to C for the ARFCN from A+1 to B. The 1st RX loss is set for ARFCNs that are equal and less than 1st ARFCN. The order of max ARFCN and RX loss are from left to right, from up to down. Please refer to Figure 15 .

Example: GSM900 (E-GSM900)

Max ARFCN	15	30	45	60	75	80	100	124	975	1000	1023	-1
RX loss (dB)	-0.25	-0.375	-0.125	0	0	-0.125	-0.5	-0.25	0.75	0.5	0	0

Note that the value –1 in Max ARFCN represents the end of setting.

ARFCN 0 ~ 15: -0.25 dB
ARFCN 16 ~ 30: -0.375 dB
ARFCN 31 ~ 45: -0.125 dB
ARFCN 46 ~ 60: 0 dB
ARFCN 61 ~ 75: 0 dB
ARFCN 76 ~ 80: -0.125 dB
ARFCN 81 ~ 100: -0.5 dB
ARFCN 101 ~ 124: -0.25 dB
ARFCN 125 ~ 975: 0.75 dB
ARFCN 976 ~ 1000: 0.5 dB
ARFCN 1001 ~ 1023: 0 dB

Figure 13 Click [Upload from flash] button to read value from flash

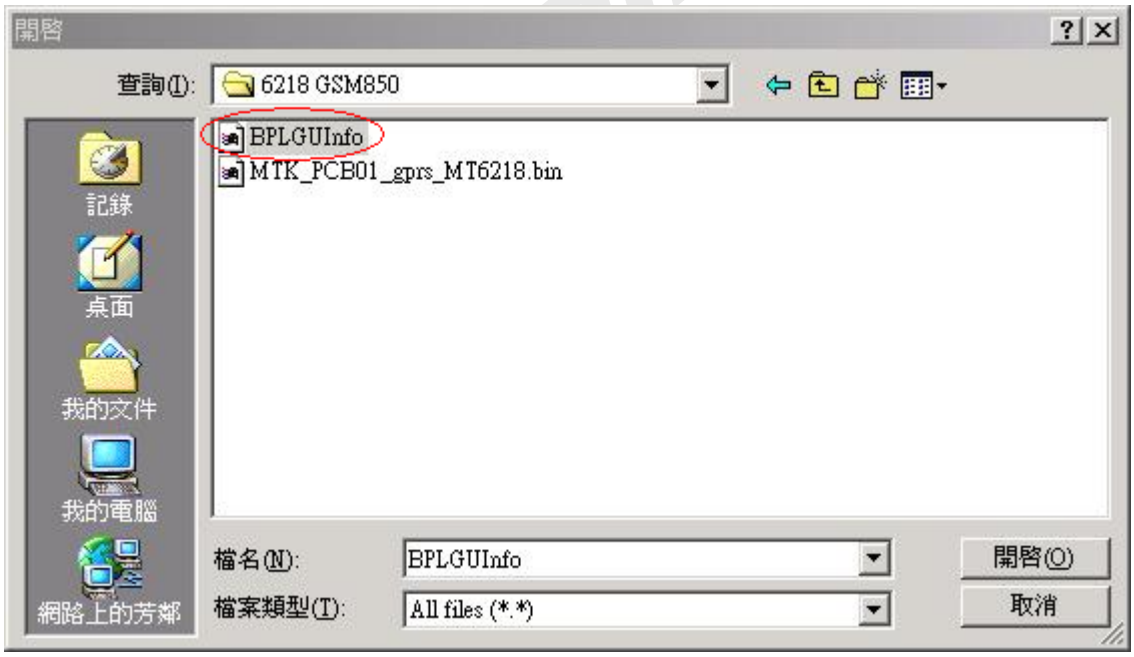

Figure 14 Select NVRAM database file if not selected before

Figure 15 Result of sub band and RX path loss value read from flash

Figure 16 Click [Download to flash] button to write value to flash

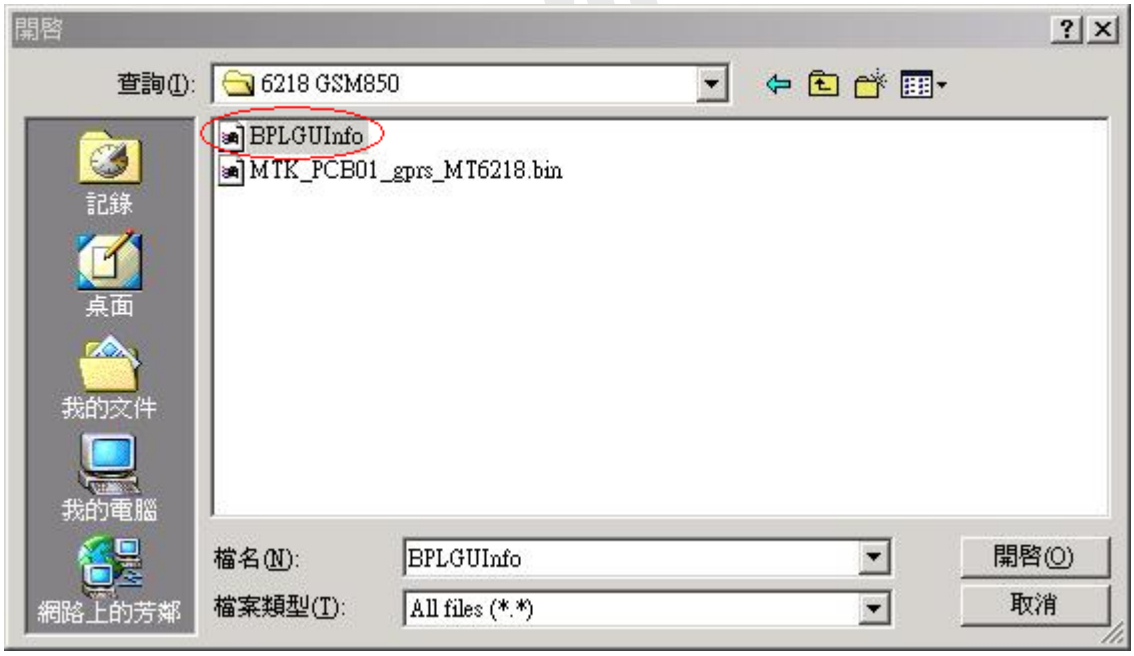

Figure 17 Select NVRAM database file if not selected before

Figure 18 Click [Load from file] button to read value from file

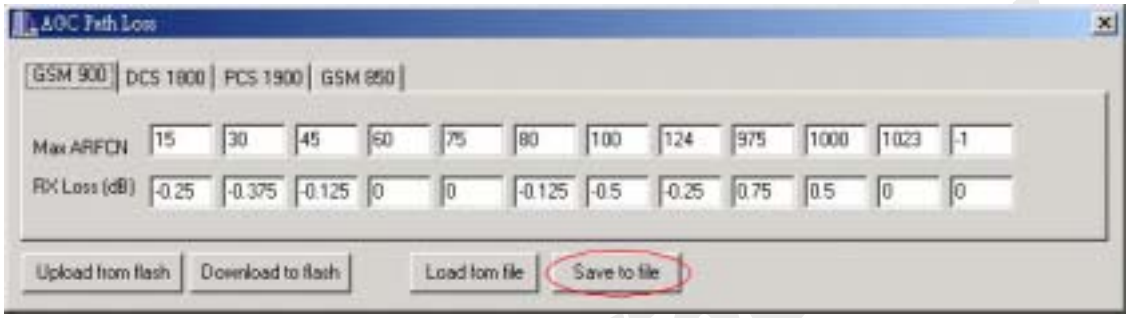

Figure 19 Click [Save to file] button to save value to file

3.2.1.2 Sub band and path loss file format

There is a special text file format when you save the sub band and path loss values. Please follow the file format if you want to change the value in file. Each number must be followed with a comma. The tool can save the path loss value with level ramp table and AFC initial value in single or multiple files.

Figure 20 Path loss values

User will get a text file after saving them. The following is a template file that contains RX loss. User will get the text file after saving maximum ARFCN and RX loss to file. Each value must be followed with a comma. Please follow the file format if you want to change the value in file. The Max ARFCN field is corresponding to the Max ARFCN field in path loss window (Figure 20) and RX loss field is corresponding to the RX loss field, too.

[GSM900 Sub band, RX loss]
Max ARFCN=15,30,45,60,75,80,100,124,975,1000,1023,-1
RX loss=-0.250,-0.375,-0.125,0.000,0.000,-0.125,-0.500,-0.250,0.750,0.500,0.000,0.0000

[DCS1800 Sub band, RX loss]
Max ARFCN=550,590,620,650,680,710,740,770,810,850,885,-1
RX loss=6.625,6.500,5.875,4.750,3.625,3.500,3.875,4.750,5.750,7.000,8.500,0.0000

[PCS1900 Sub band, RX loss]
Max ARFCN=550,810,-1,0,0,0,0,0,0,0,0
RX loss=0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.000,0.0000

Note : -1 indicates the end of the column Max_ARFCN

3.2.2 Gain sweep

Gain Sweep is used for measuring the power of the indicated channel by the different gains.

User can execute Gain Sweep function by following steps:
1) Input Band, ARFCN, PM/Frame, PM Count, Min Gain, Max Gain, and Step Gain.
2) Click Start button.
3) Meta will shows the PM result : Band, ARFCN, DSP Power, Antenna Power, Used Gain, and Deviation.
4) User can stop this operation by clicking Stop button.

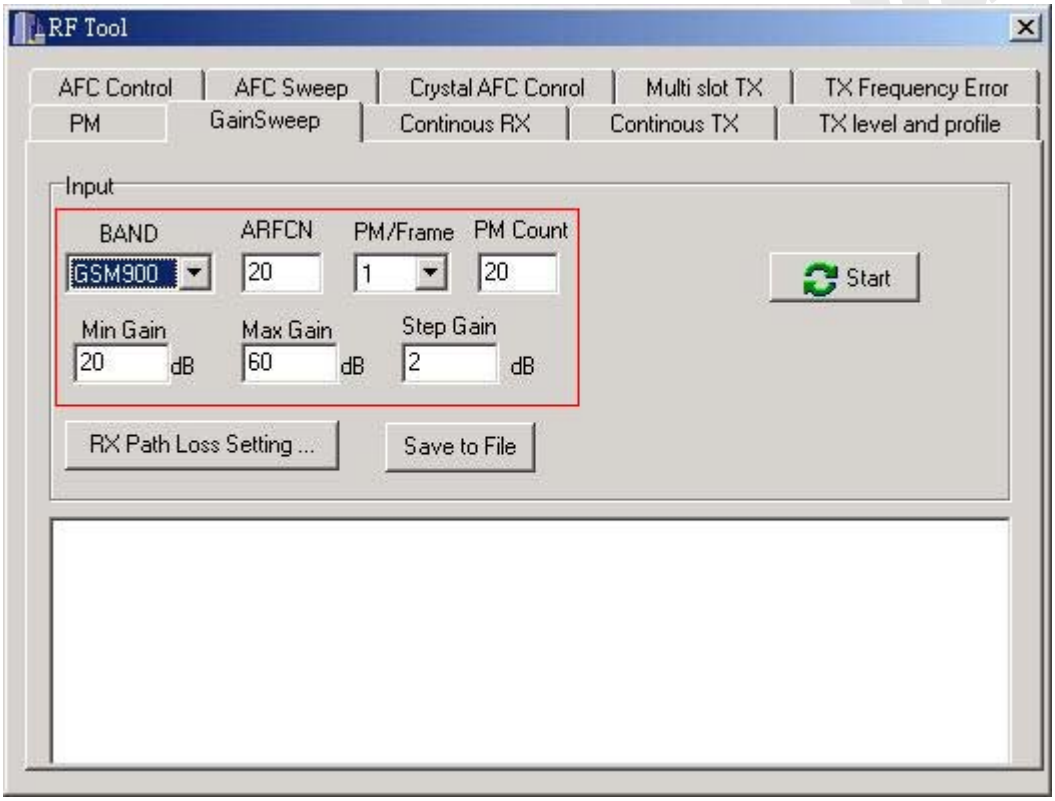

Figure 21 Input Band, ARFCN, PM/Frame, PM Count, Min Gain, Max Gain, and Step Gain.

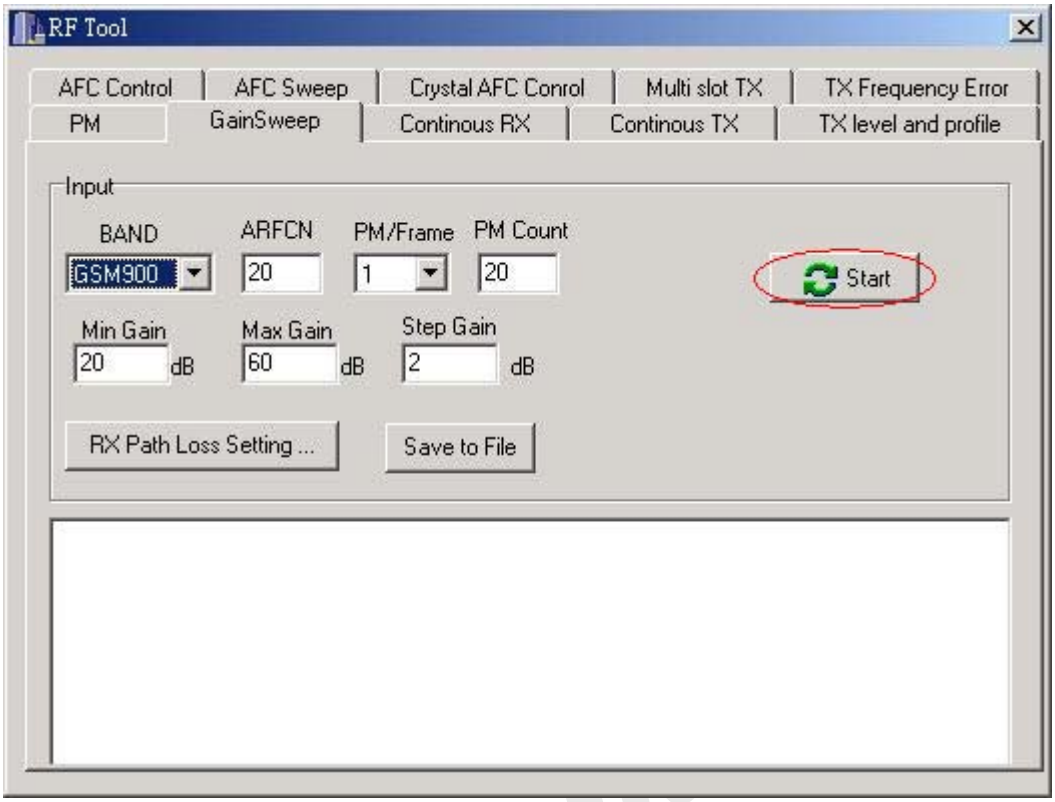

Figure 22 Click [Start] button

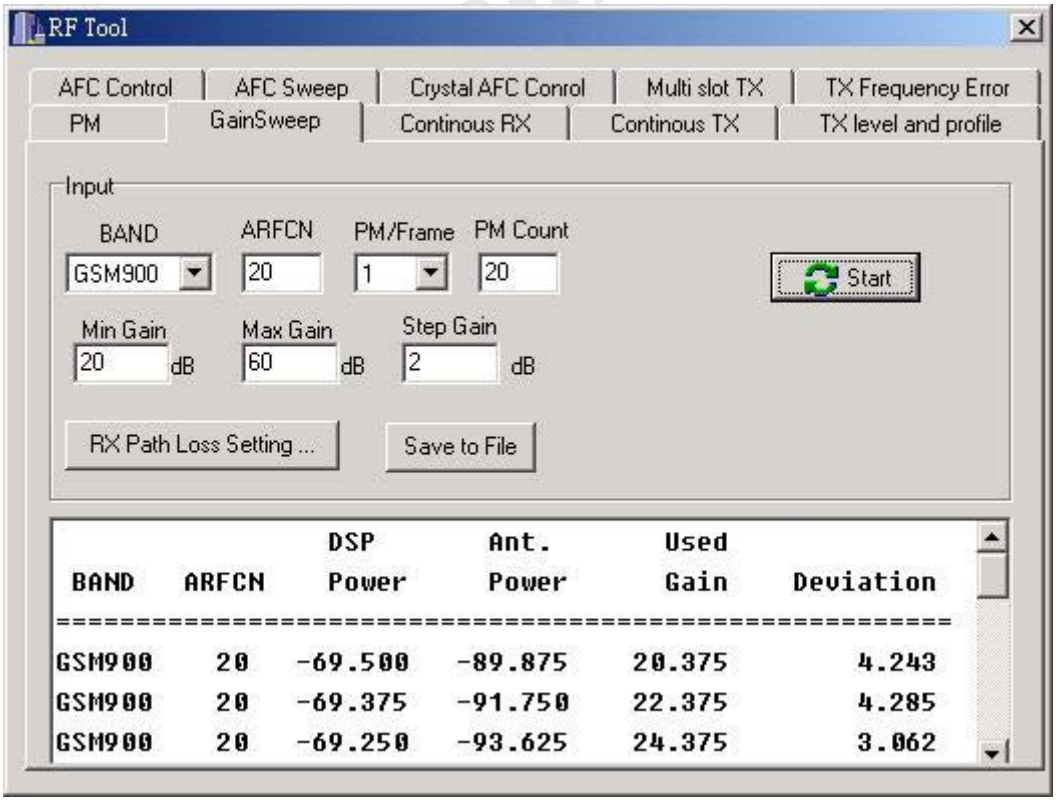

Figure 23 Meta shows gain sweep results

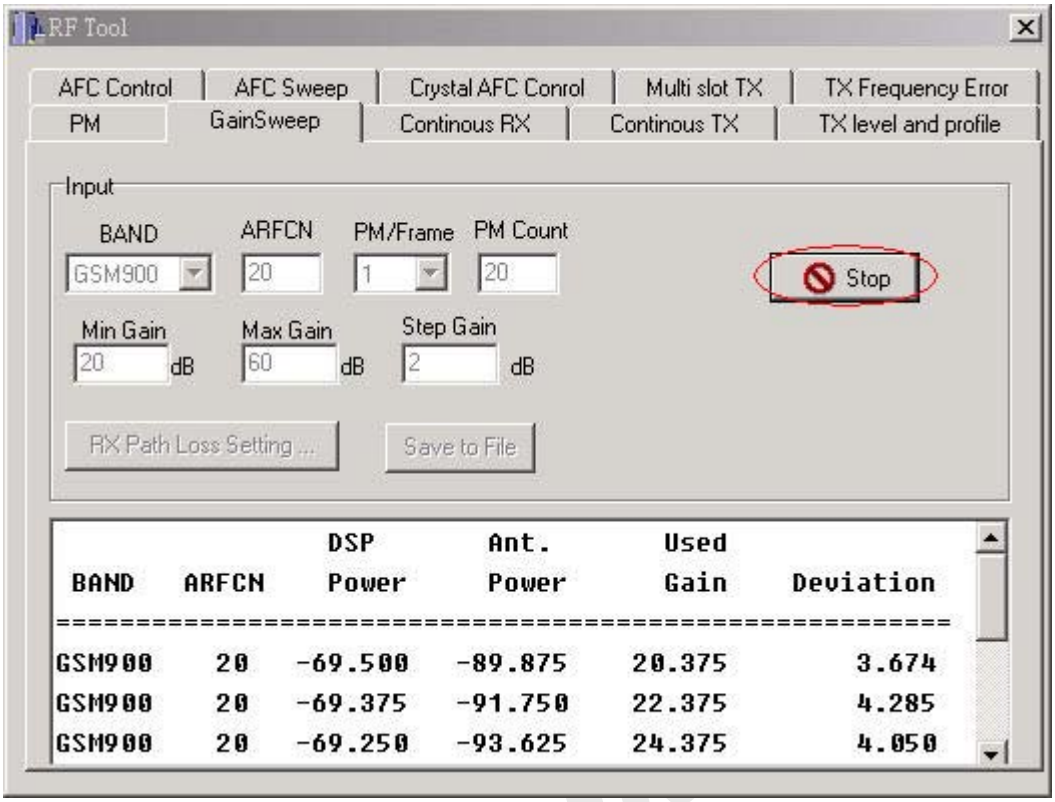

Figure 24 Click [Stop] button to stop gain sweep operation

User can click [*RX Path Loss Setting]* button to show the AGC Path Loss window. Please refer to section 3.2.1.1.

3.2.3 Continuous RX

Continue RX is used for observing RX IQ. User can input ARFCN and Gain (dB) and then click [Start] button to do continuous RX testing. When user wants to stop RX, he can click [Stop] button.

MS will start to do continuous RX of the ARFCN with the gain set by user after getting the continuous RX command from META. It will test RX function of RF module.

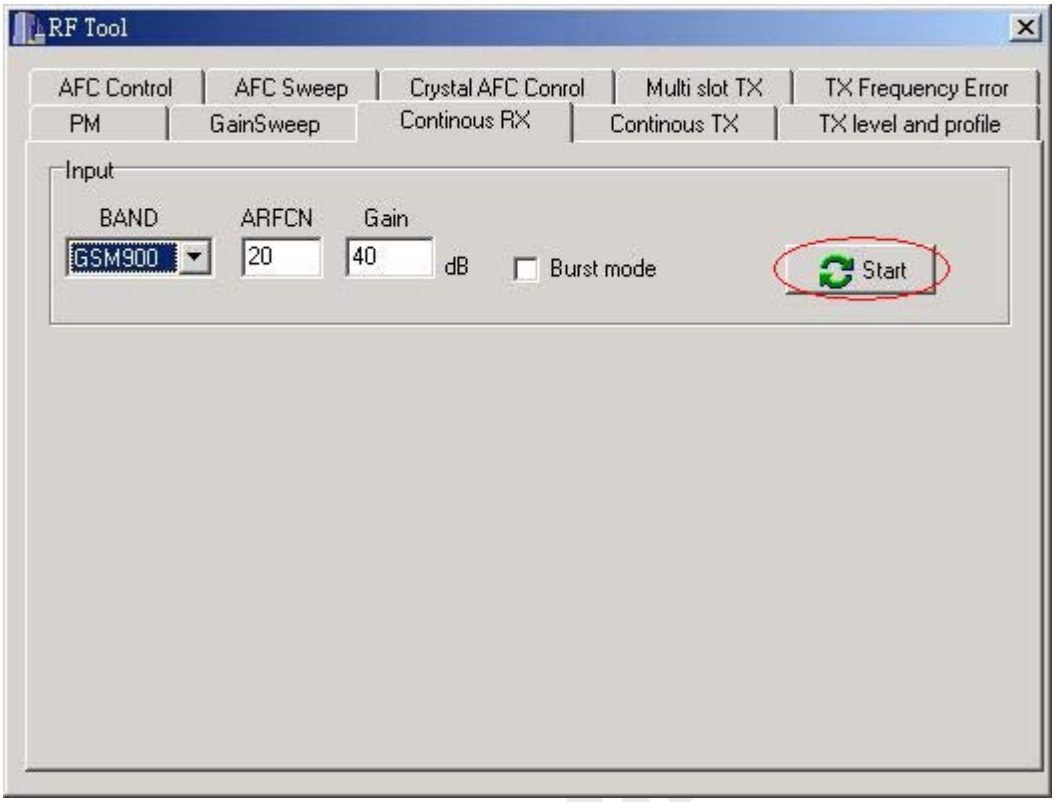

Figure 25 Click [Start] button to start continuous RX testing

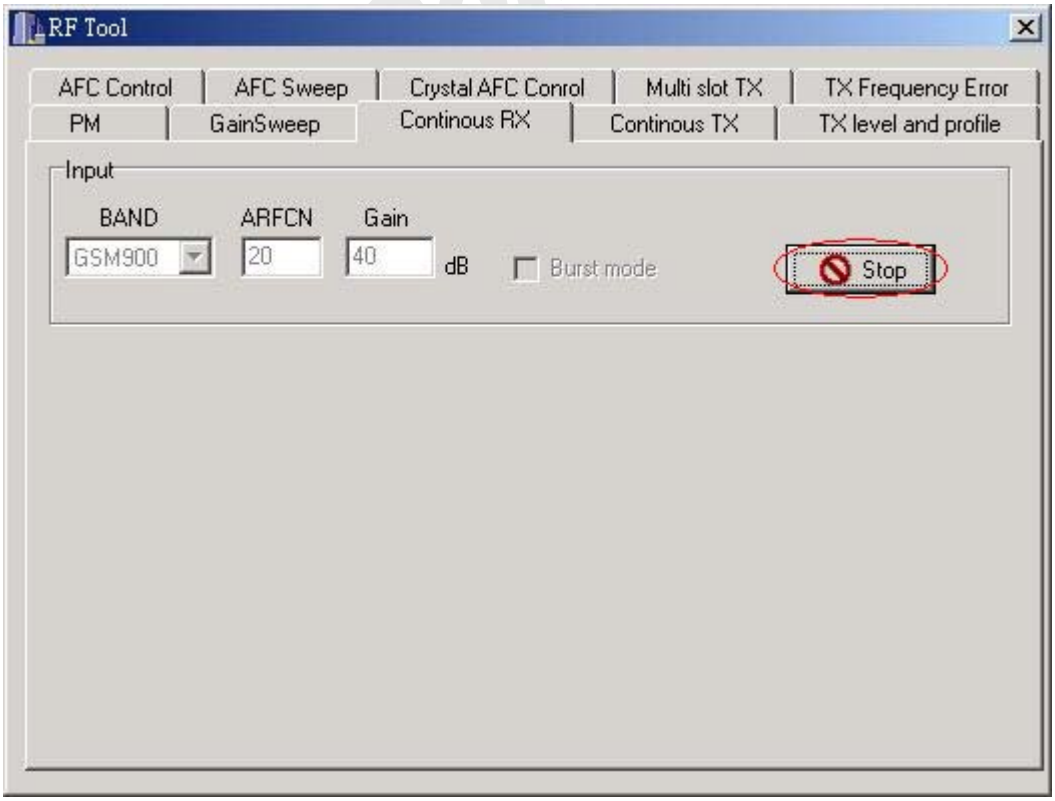

Figure 26 Click [Stop] button to stop continuous RX testing

After clicking [Stop] button, the caption of button will be changed to [Start].

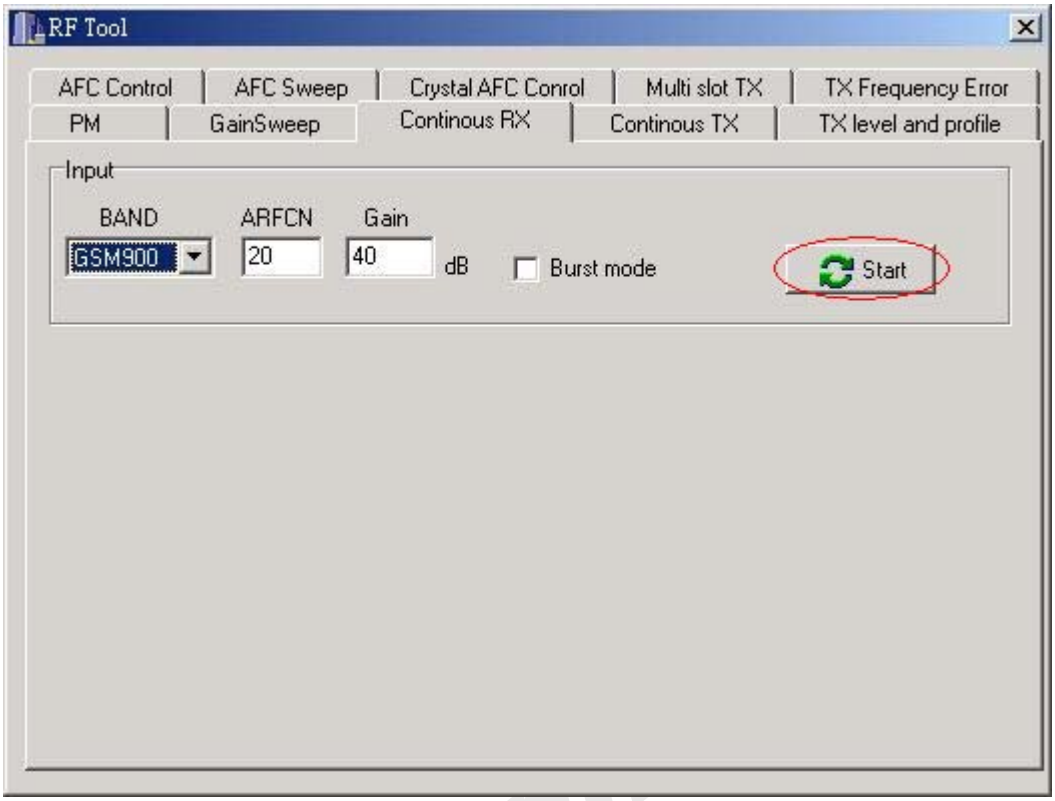

Figure 27 The caption of button will change to [Start]

3.2.4 Continuous TX

Continue TX is used for observing TX IQ. Power amplifier is turned off in this operation. User can input ARFCN value, select BB TX parameters, chose pattern and then click [Start] button to start continuous TX test. After starting continuous TX, the caption of the button will change to [Stop]. User can click [Stop] button to stop it.

MS will start to do TX except for PA circuit on the ARFCN assigned by user continuously after getting the continuous TX command from META. It will test TX function of RF module in MS.

Note: The meaning of BB TX parameters is as follows.

- APC bat low voltage: This field is used to setup APC's voltage compensation threshold under low battery voltage. The unit is voltage.
- APC bat high voltage: This field is used to setup APC's voltage compensation threshold under high battery voltage. The unit is voltage.
- APC bat low temperature: This field is used to setup APC's temperature compensation threshold under low battery temperature. The unit is degree.
- APC bat high temperature: This field is used to setup APC's temperature compensation threshold under high battery temperature. The unit is degree.

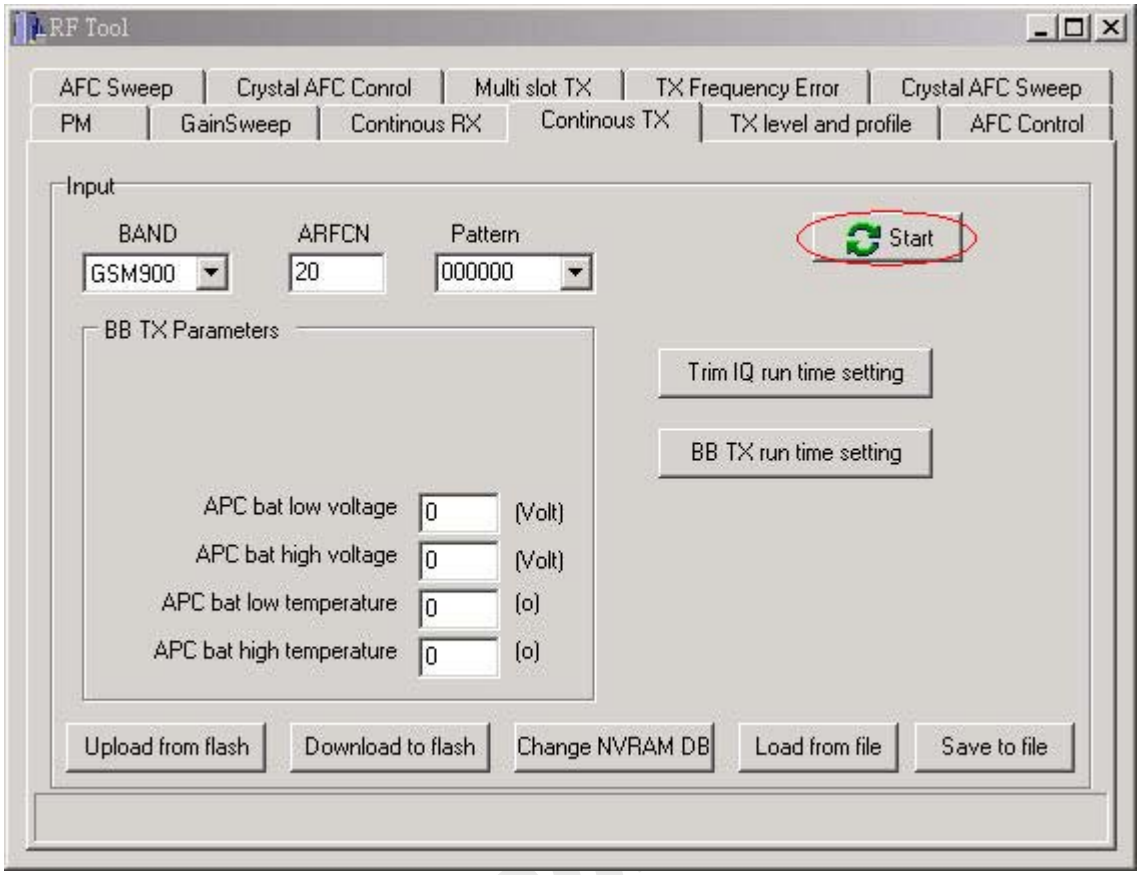

Figure 28 Click [Start] button to start testing

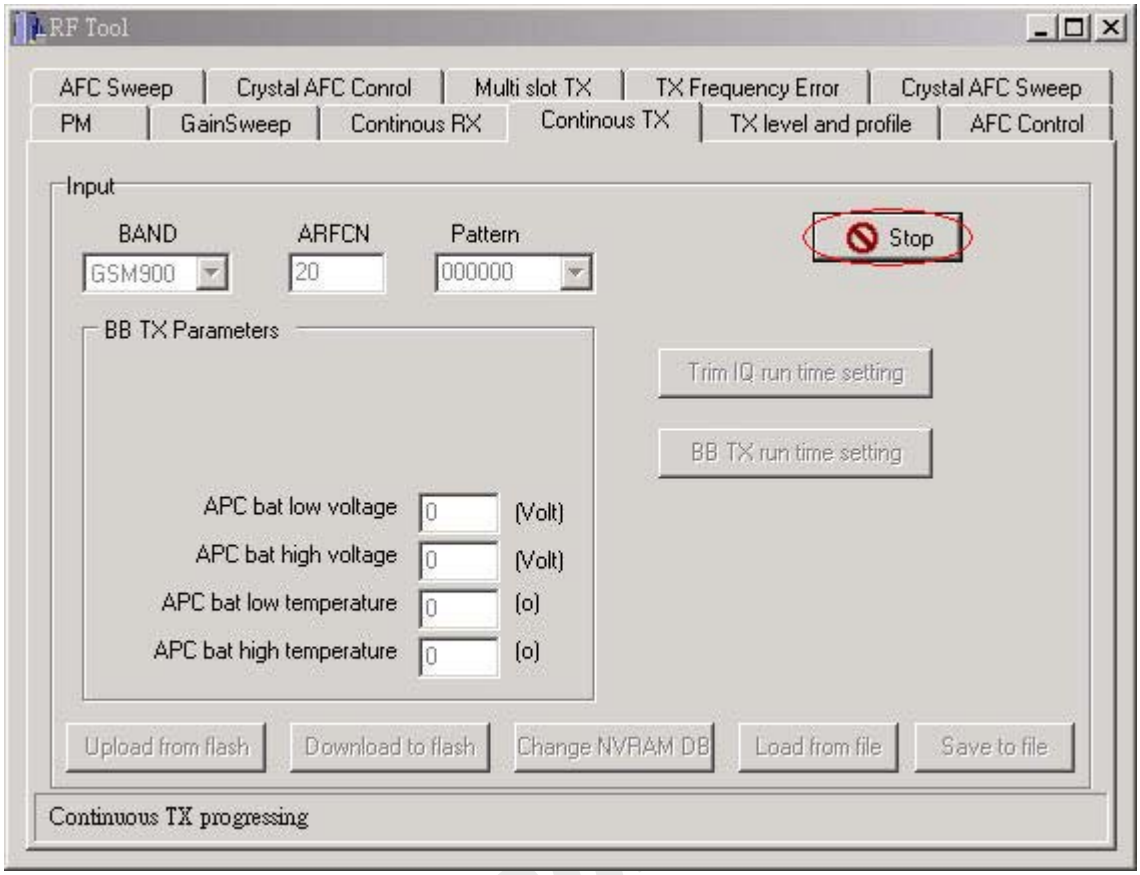

Figure 29 Click [Stop] button to stop testing

After clicking [Stop] button, the caption of button will change to [Start].

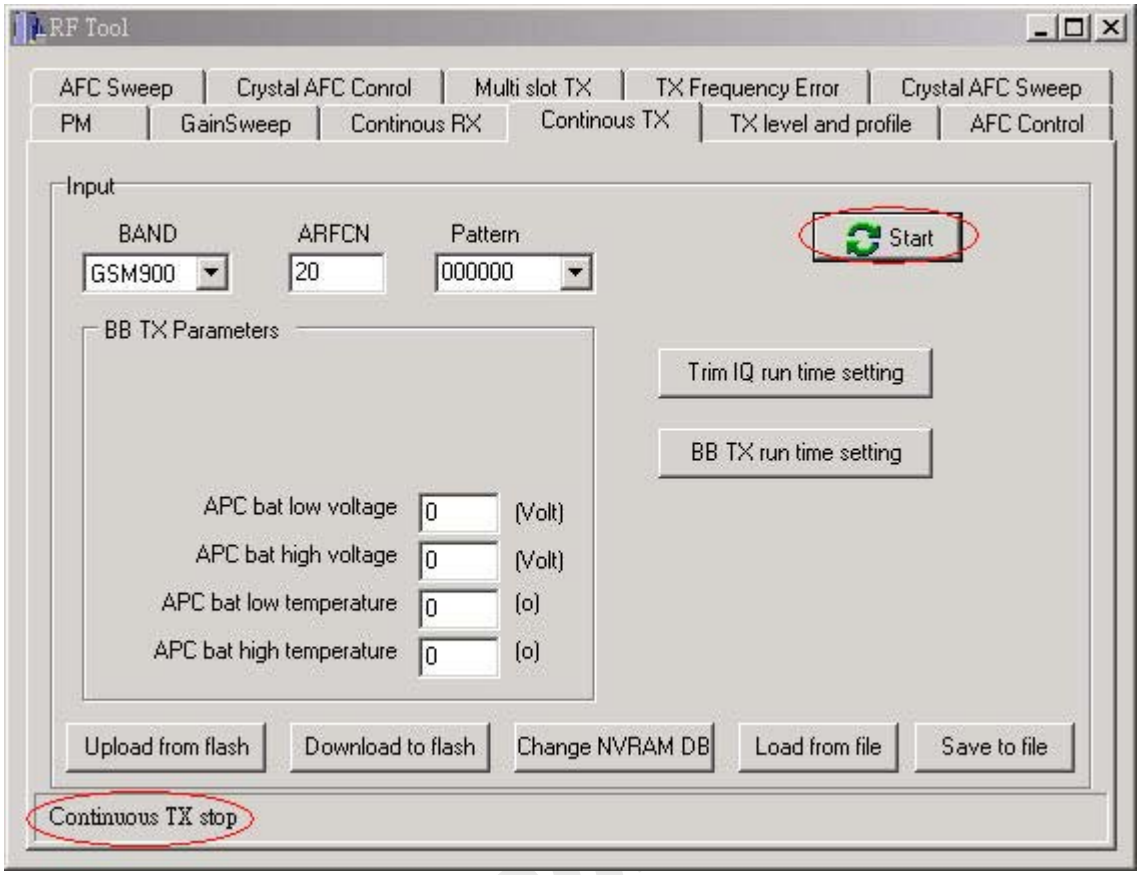

Figure 30 The caption of button will change to [Start]

3.2.4.1 Upload and download BB TX parameter in flash

User can click [Upload from flash] button to read BB TX parameter from flash and click [Download to flash] button to write BB TX parameter to flash.

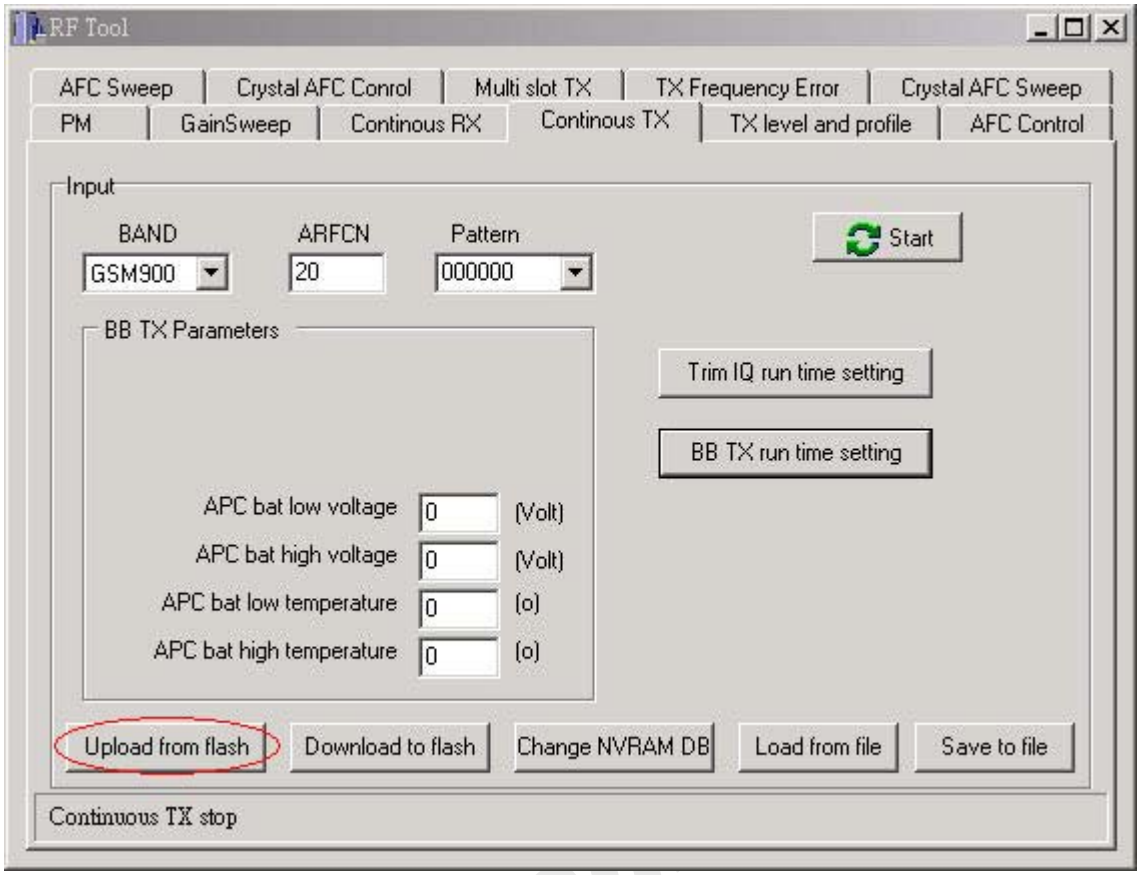

Figure 31 Click [Upload from flash] button to read BB TX parameter from flash

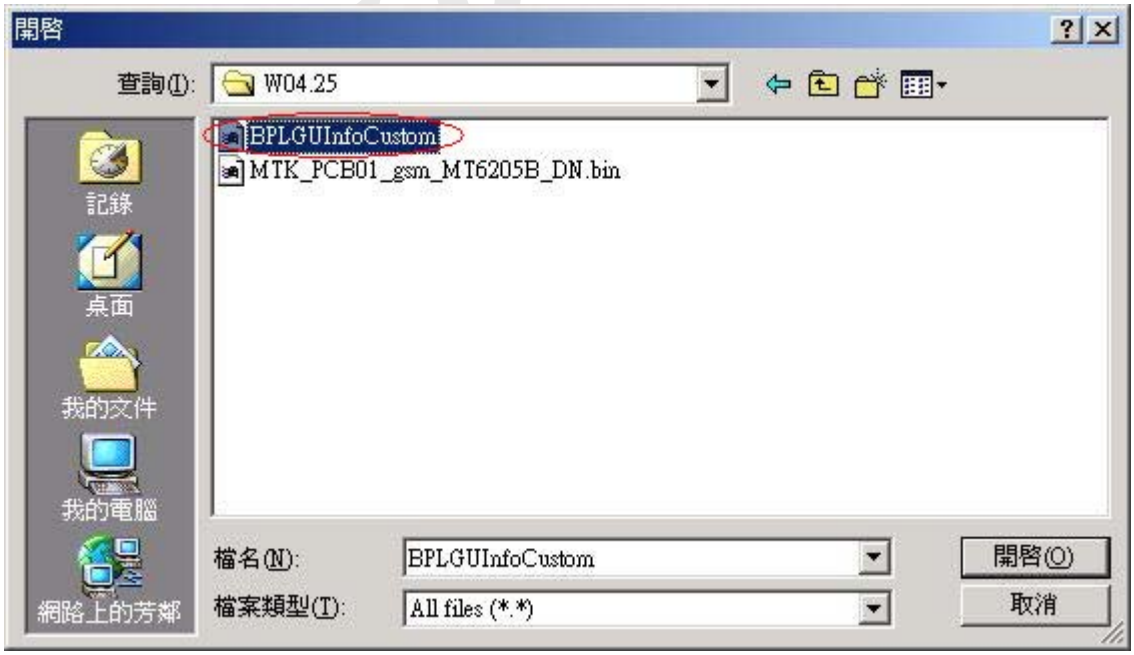

Figure 32 Select NVRAM database file if not selected before

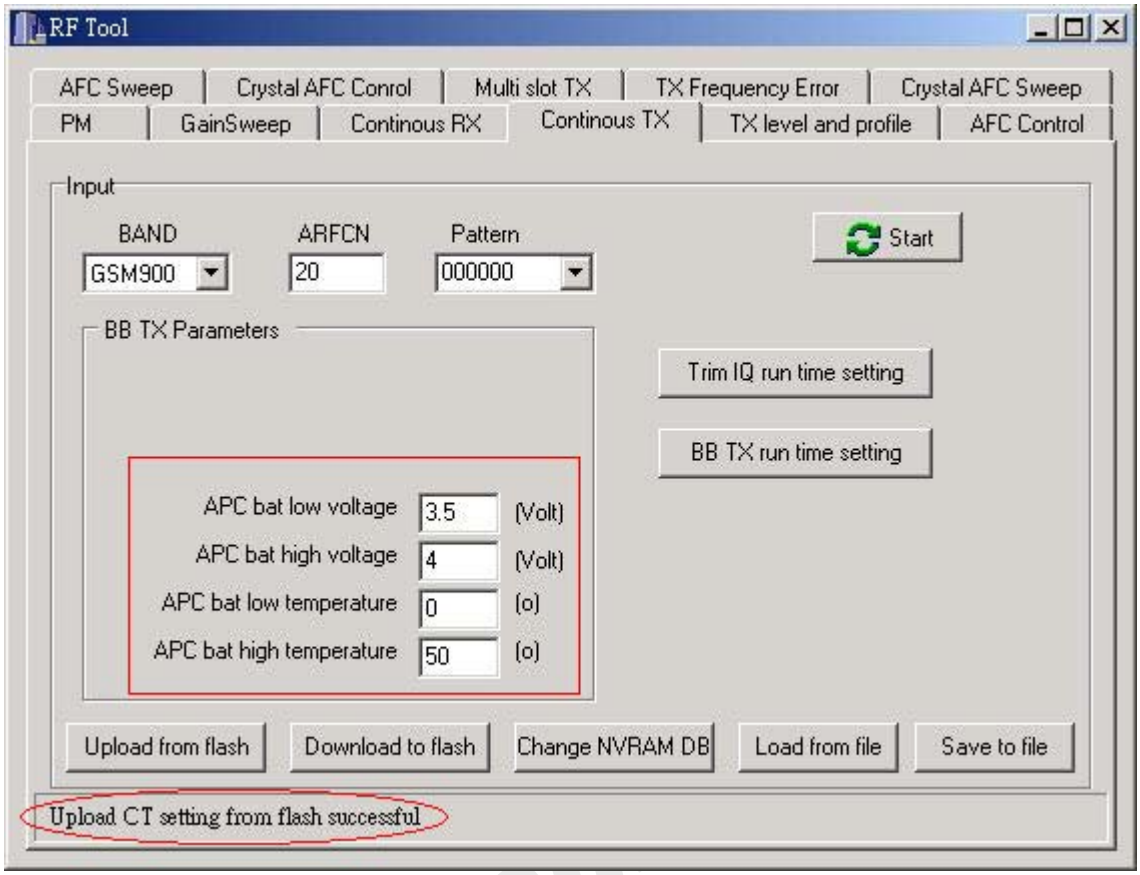

Figure 33 BB TX parameter result

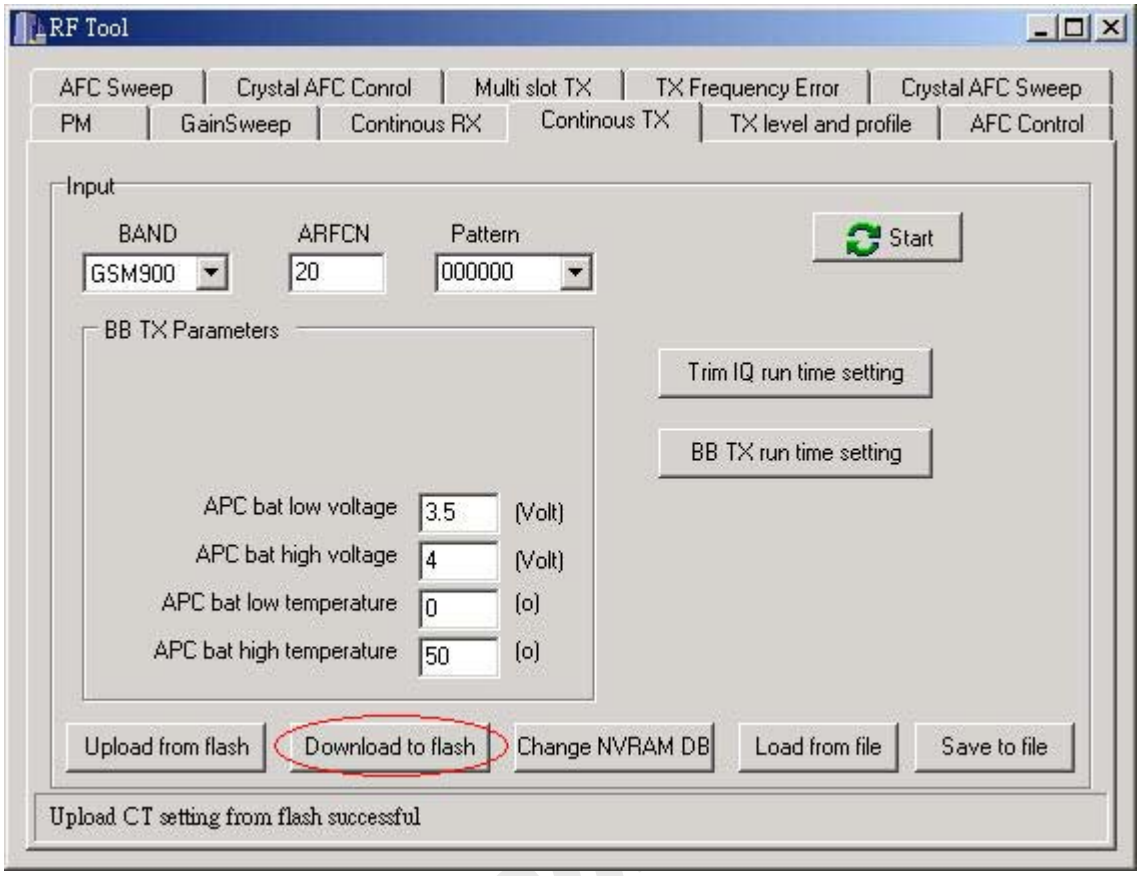

Figure 34 Click [Download to flash] button to download BB TX parameter to flash

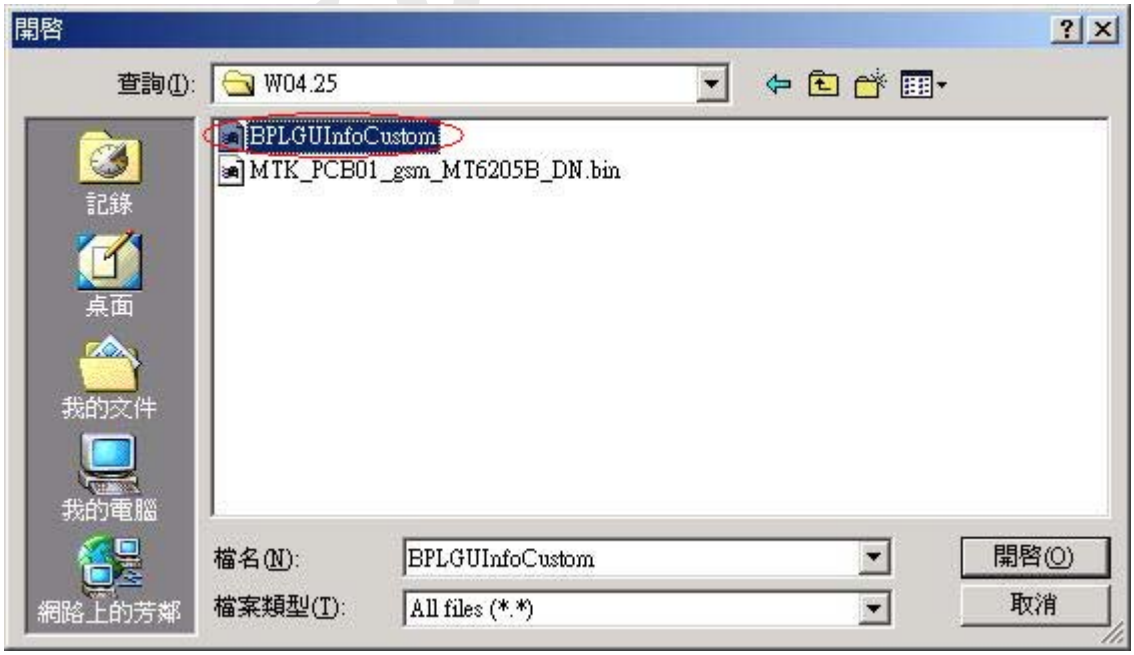

Figure 35 Select NVRAM database file if not selected before

If User wants to change NVRAM database file, he can click [Change NVRAM DB] button.

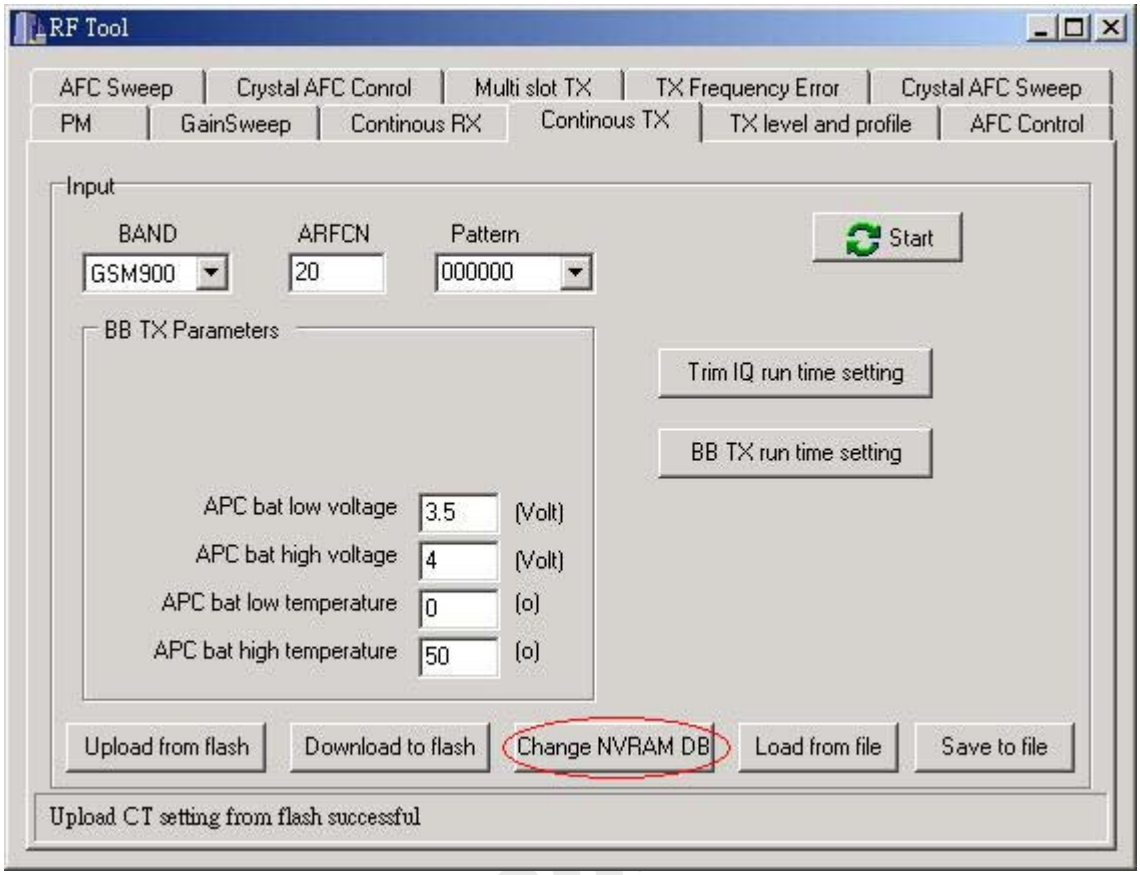

Figure 36 Click [Change NVRAM DB] to change NVRAM database file

3.2.4.2 Read and write BB TX parameter in file

User can click [Load from file] button to read BB TX parameter from file and click [Save to file] button to write BB TX parameter to file.

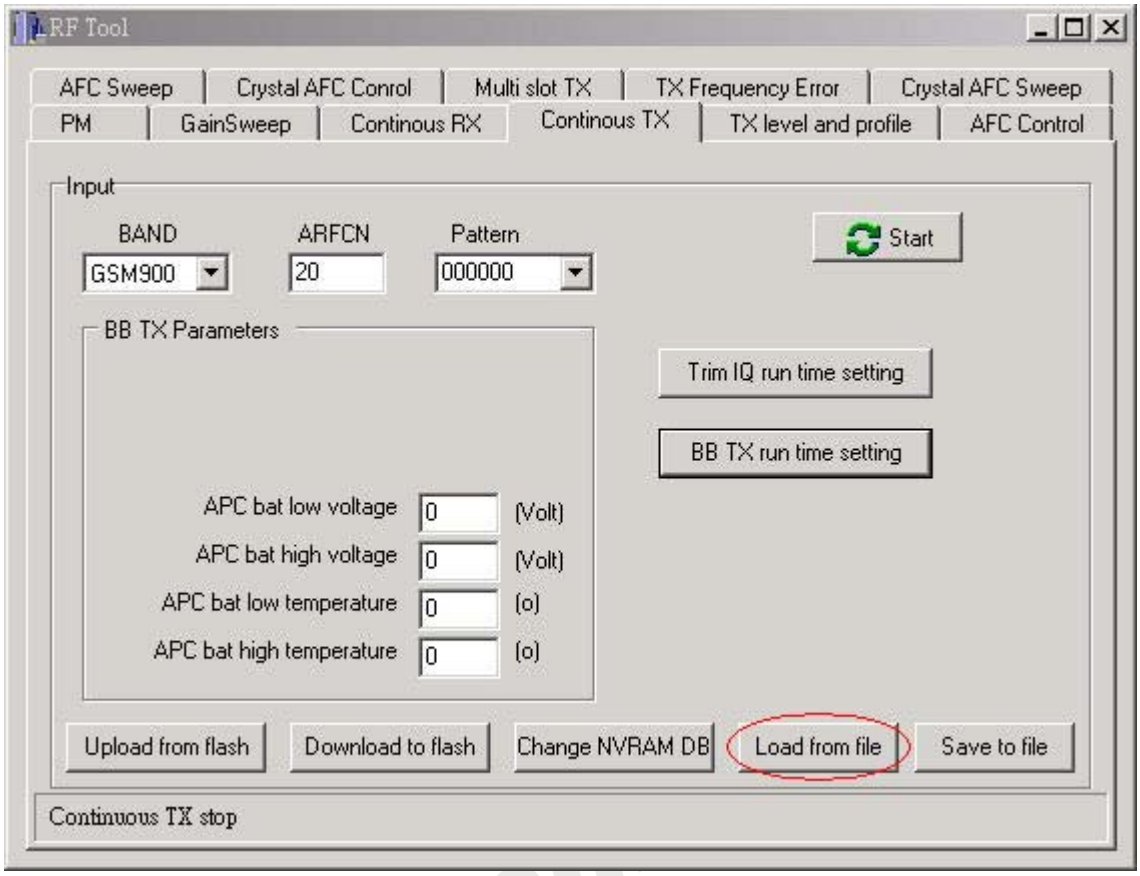

Figure 37 Click [Load from file] button to read BB TX parameter from file

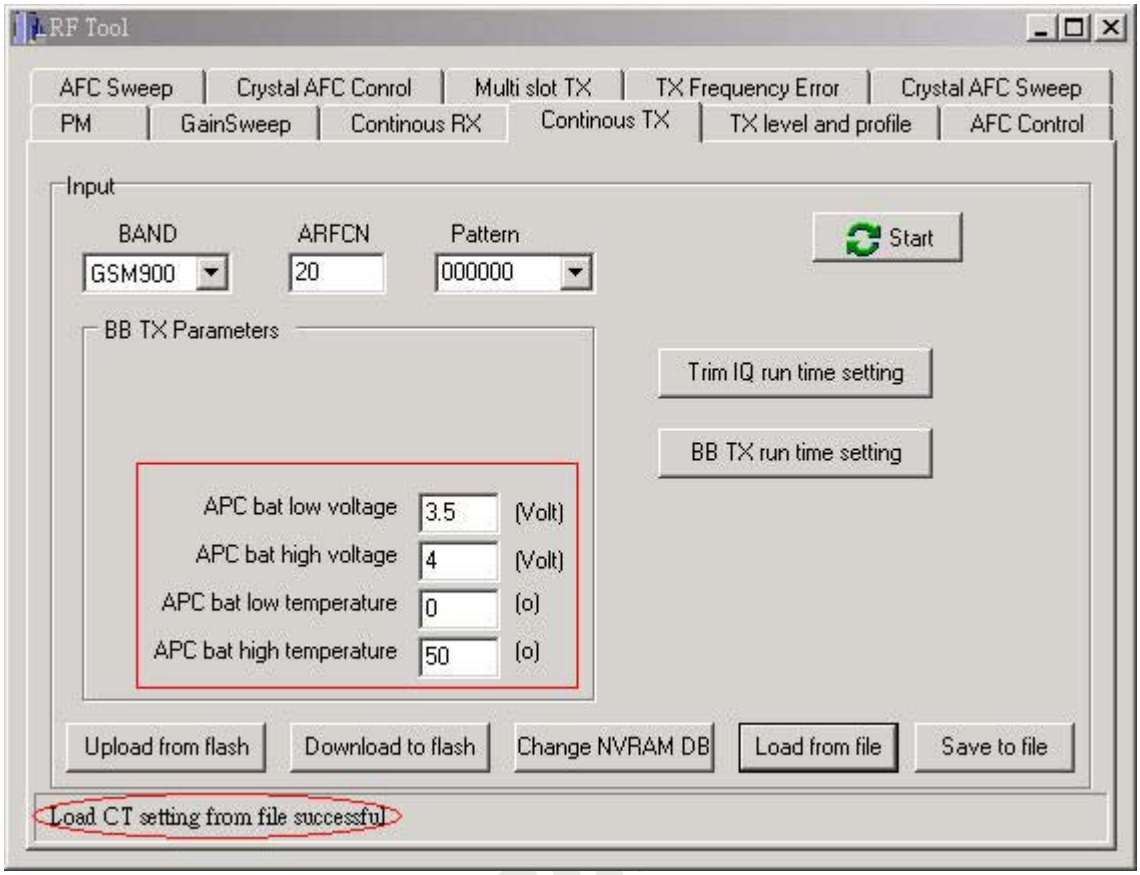

Figure 38 BB TX parameter result

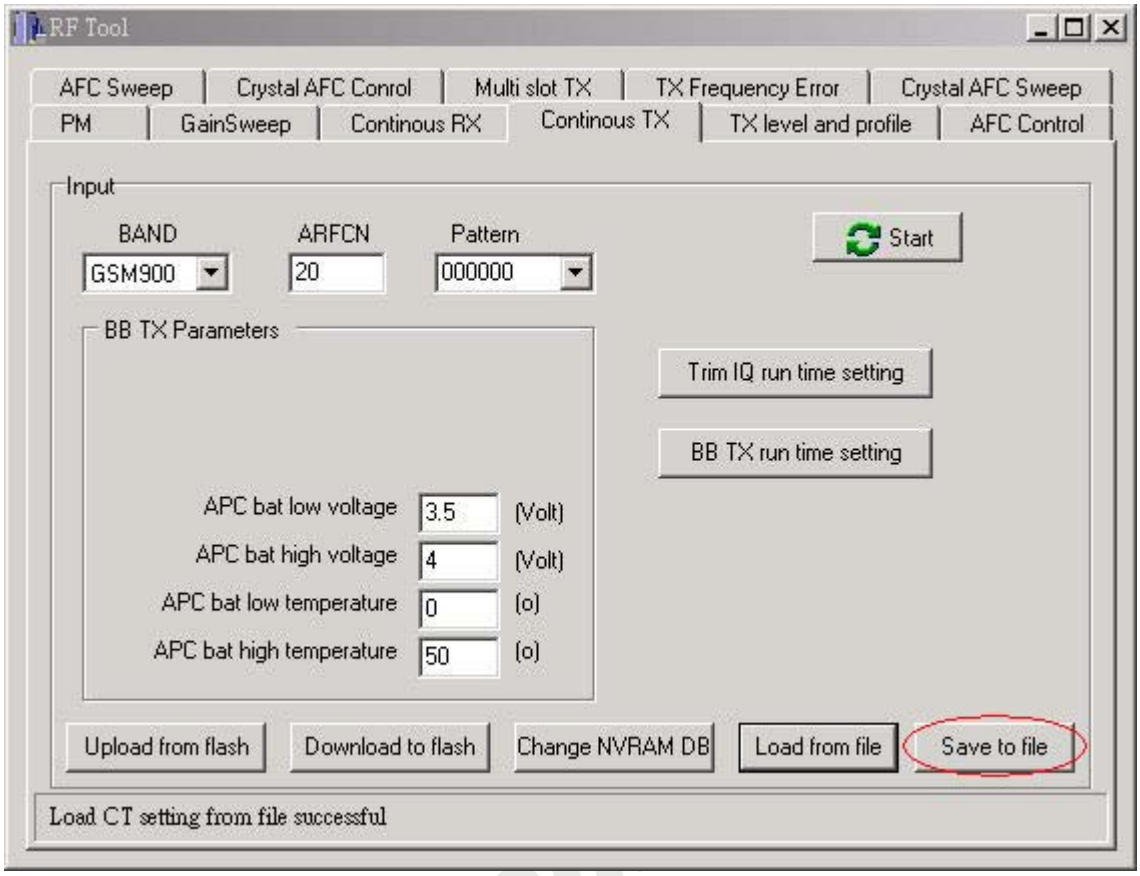

Figure 39 Click [Save to file] button to save BB TX parameter to file

The following is a template file of BB TX parameter. User will get the text file after saving BB TX parameter to file.

[BB TX Parameters]
APC bat low voltage=3.5
APC bat high voltage=4
APC bat low temperature=0
APC bat high temperature=50

3.2.4.3 Trim IQ run time setting

User can click [Trim IQ run time setting] button to show trim IQ and offset IQ run time setting window.

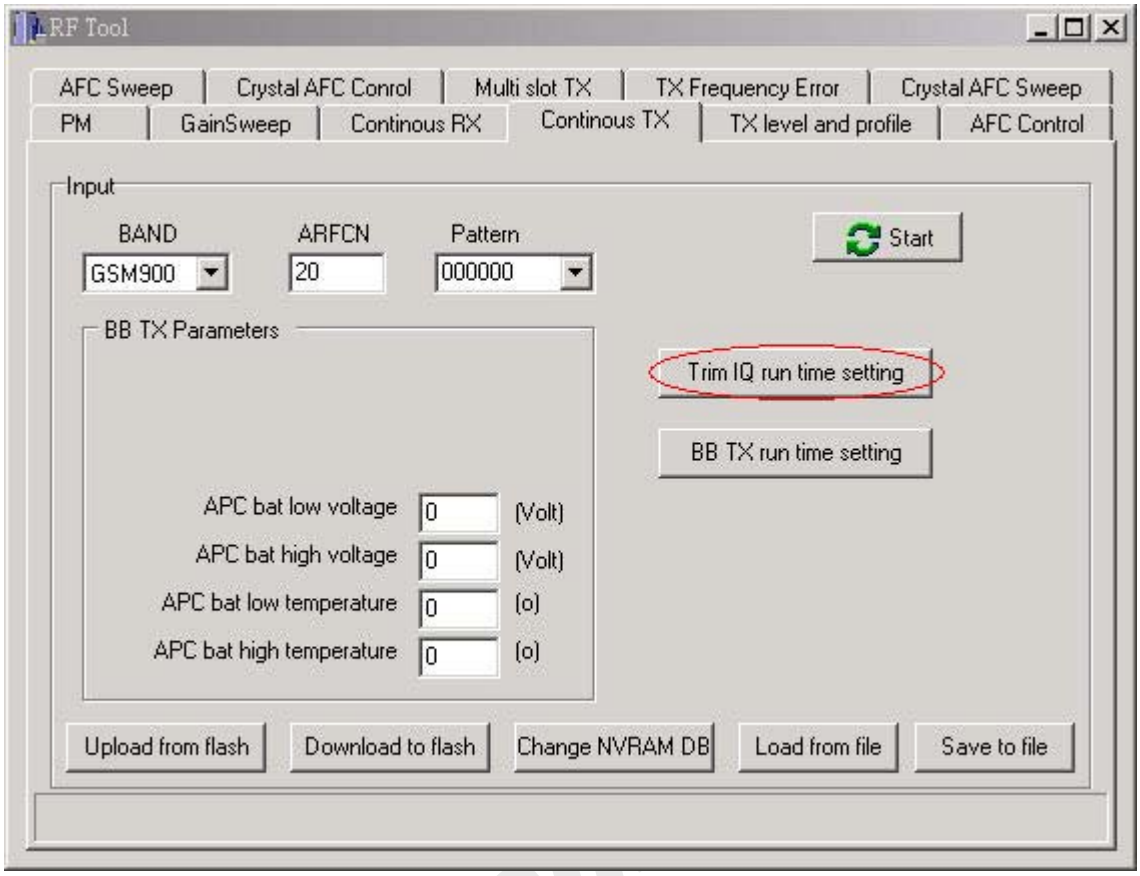

Figure 40 Click [Trim IQ run time setting] button to enter trim IQ and offset IQ run time setting window

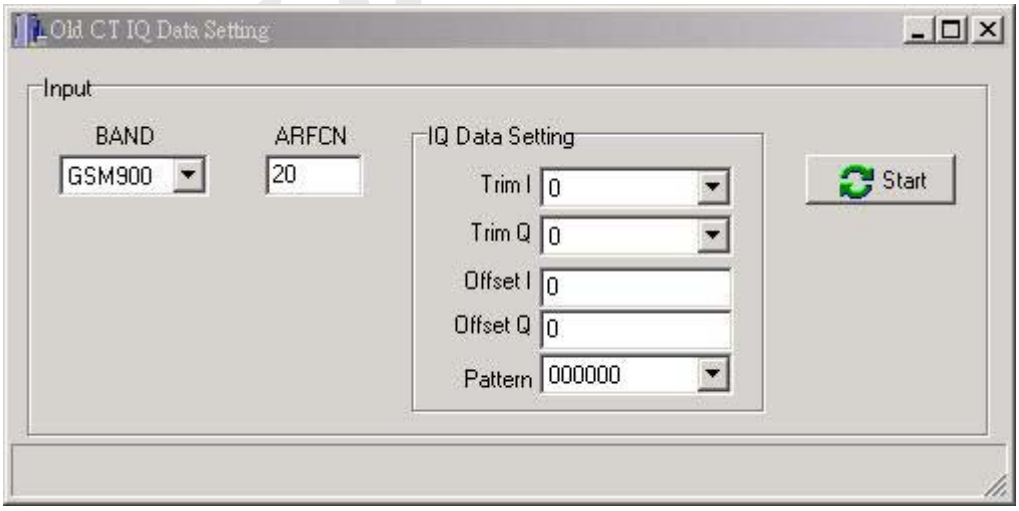

Figure 41 Trim IQ and offset IQ run time setting window

Trim IQ and offset IQ run time setting window is used for user to tune trim IQ and offset IQ. Power amplifier is turned off in this operation. User can input band, ARFCN value, trim IQ, offset IQ and chose pattern and then click [Start] button to start continuous TX test. After starting continuous TX, the caption of the button will change to [Stop]. User can click [Stop] button to stop it.

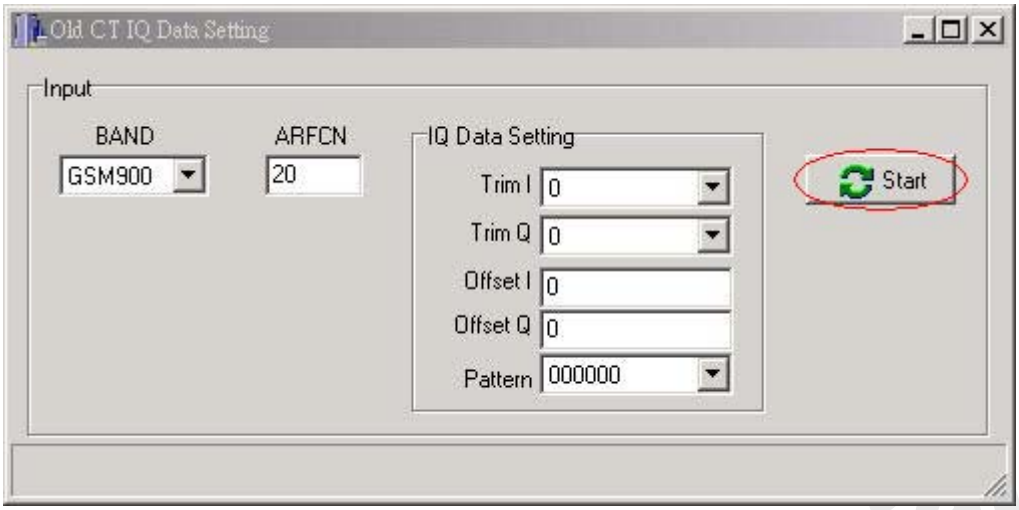

Figure 42 Click [Start] button to start testing

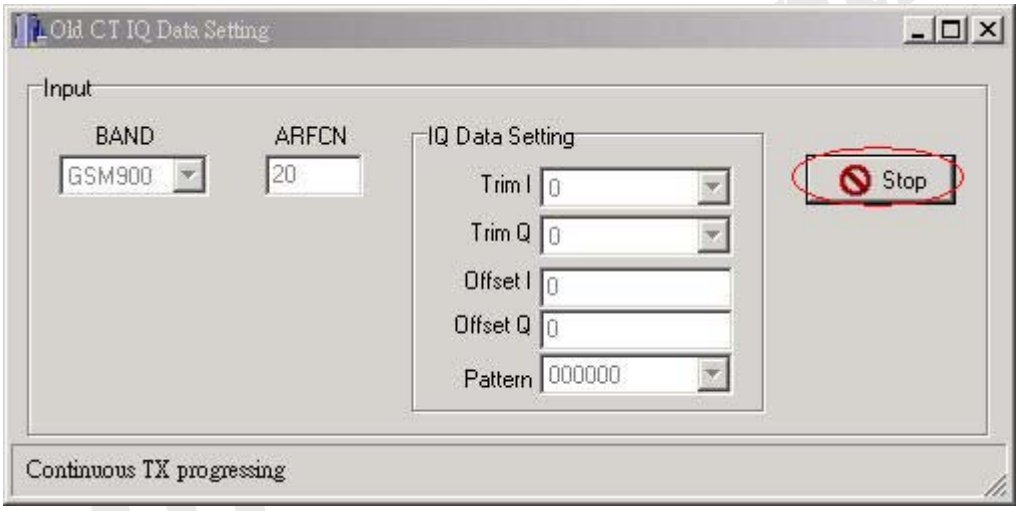

Figure 43 Click [Stop] button to stop testing

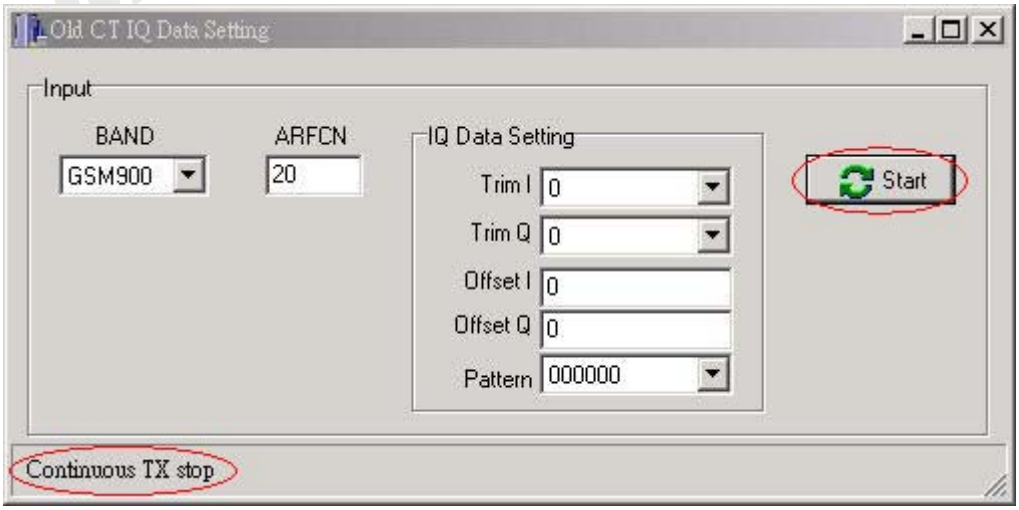

Figure 44 The caption of button will change to [Start]

Note: The meaning of Trim I, Trim Q and Offset I, Offset Q is as follows.

- Trim I: The field is used to control gain trimming of I-channel DAC in BBTX mixed-signal module.
- Trim Q: The field is used to control gain trimming of Q-channel DAC in BBTX mixed-signal module.
- Offset I: The field is used to control value of offset cancellation for I-channel DAC in TX mixed-signal module.
- Offset Q: The field is used to control value of offset cancellation for Q-channel DAC in TX mixed-signal module.

3.2.4.4 BB TX run time setting

User can click [BB TX run time setting] button to show BB TX run time setting window.

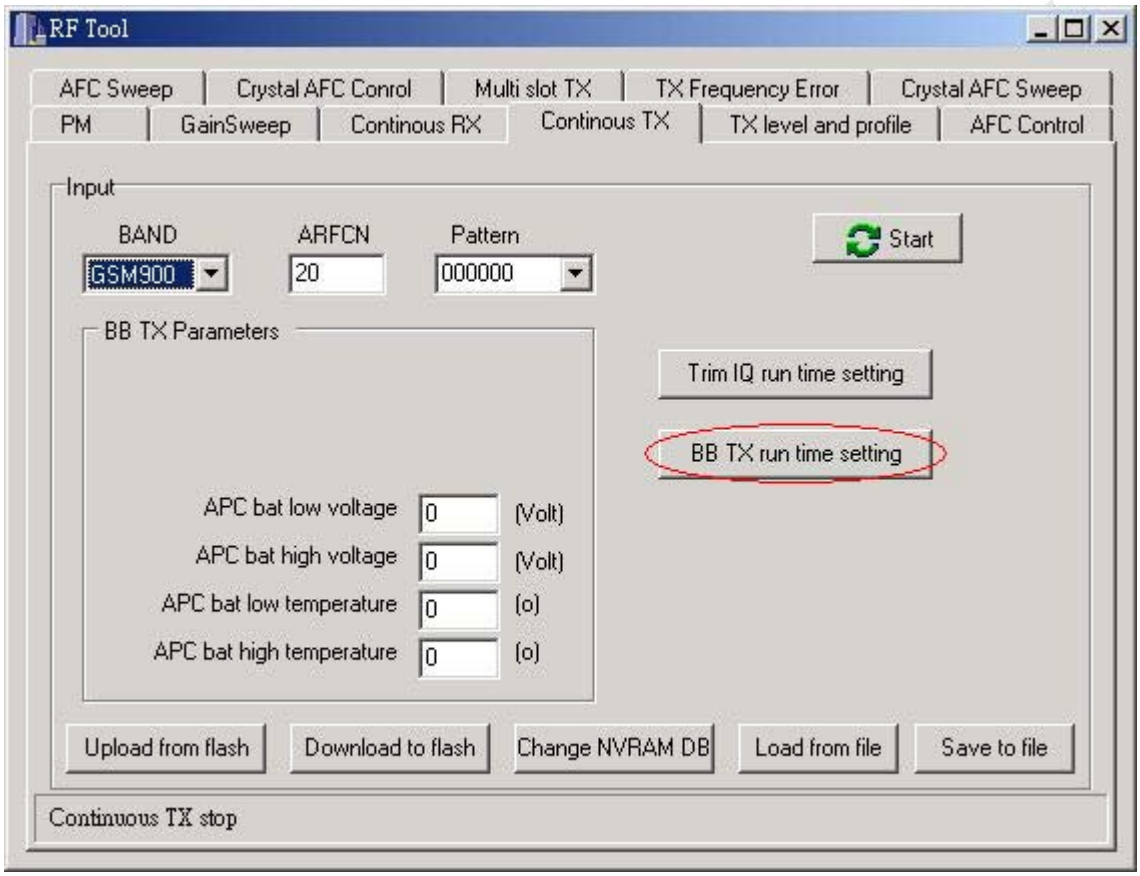

Figure 45 Click [BB TX run time setting] button to enter BB TX run time setting window

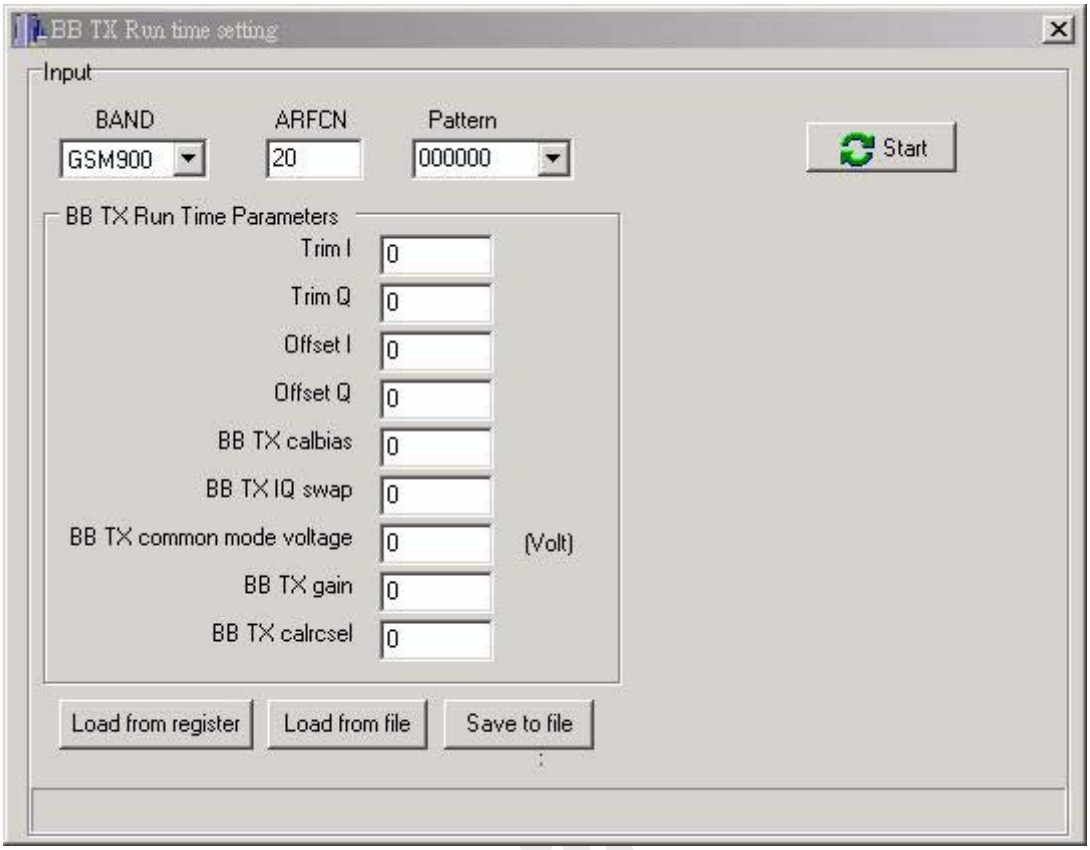

Figure 46 BB TX run time setting window

BB TX run time setting window is used for user to adjust BB TX run time parameter. Power amplifier is turned off in this operation. User can input band, ARFCN value, BB TX run time parameters and chose pattern and then click [Start] button to start continuous TX test. After starting continuous TX, the caption of the button will change to [Stop]. User can click [Stop] button to stop it.

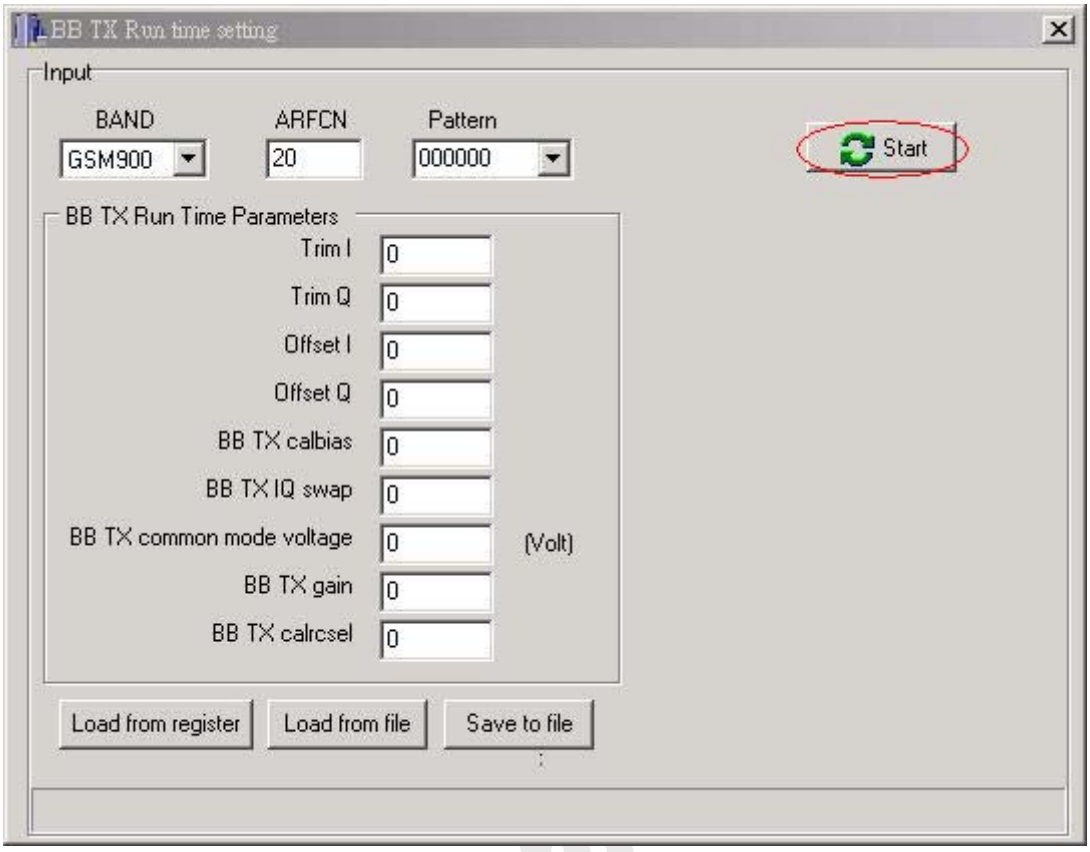

Figure 47 Click [Start] button to start testing

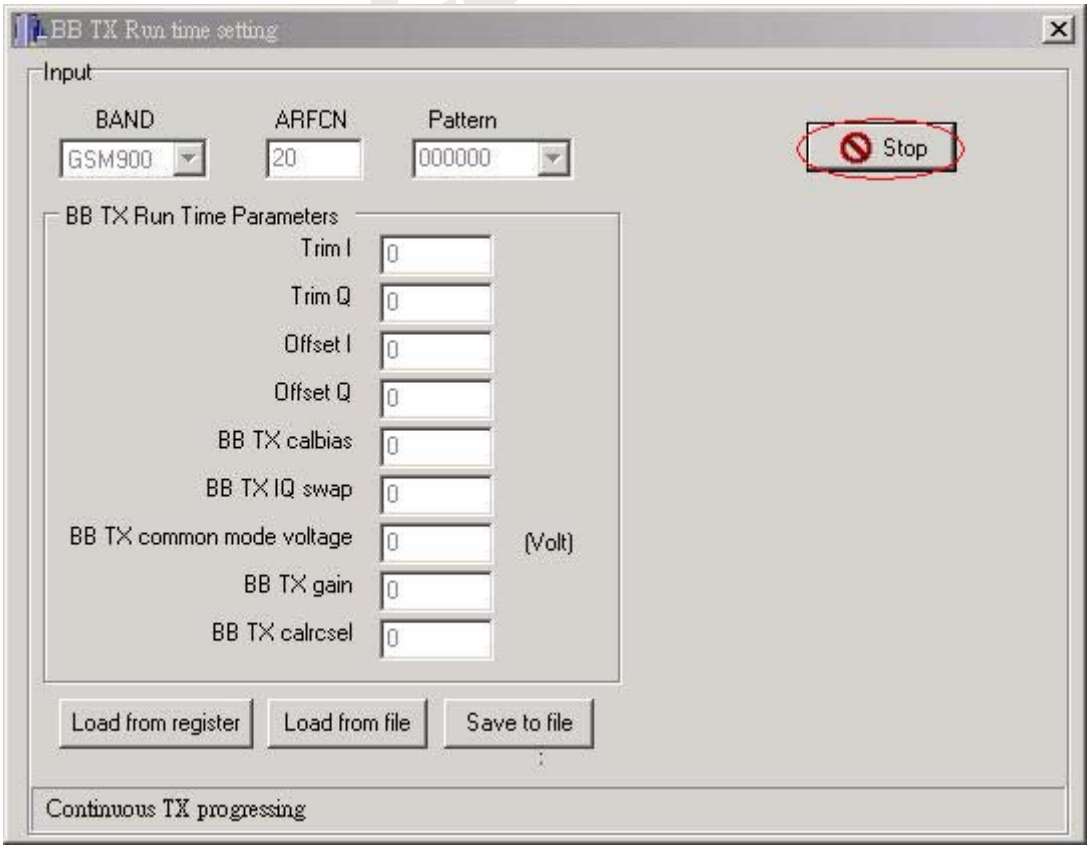

Figure 48 Click [Stop] button to stop testing

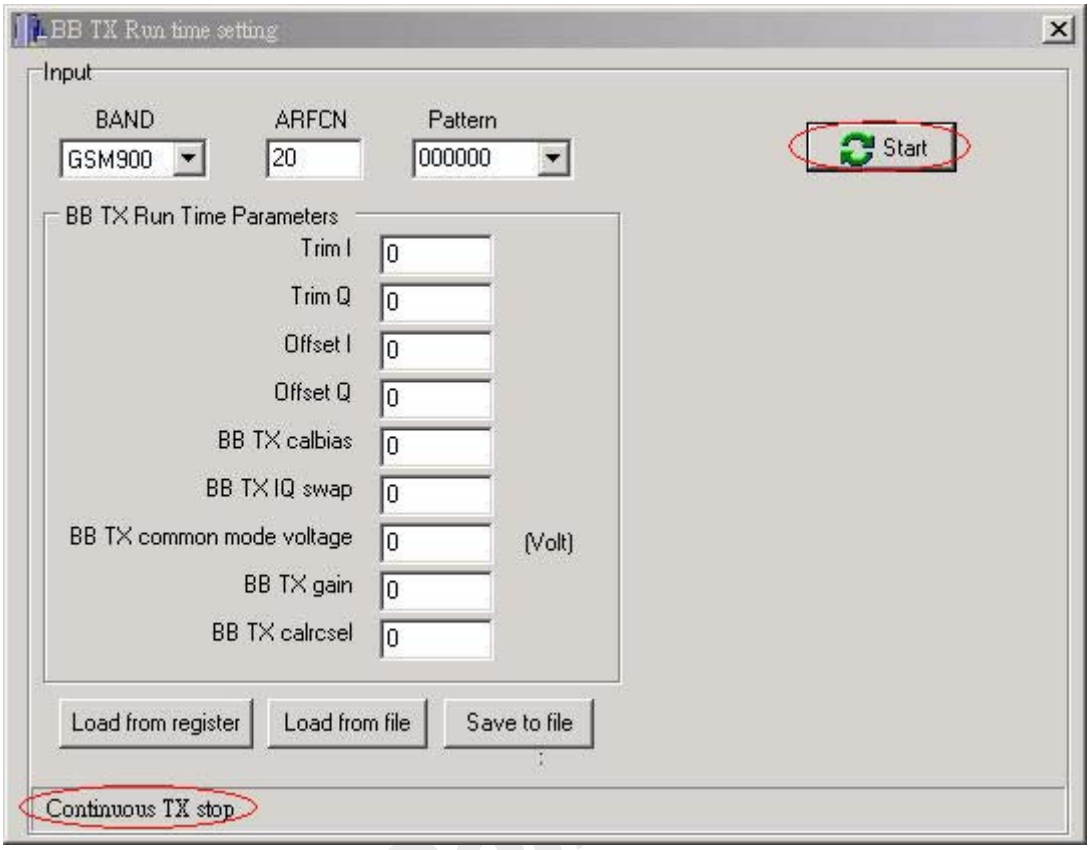

Figure 49 The caption of button will change to [Start]

User can click [Load from register] button to load BB TX run time setting from register.

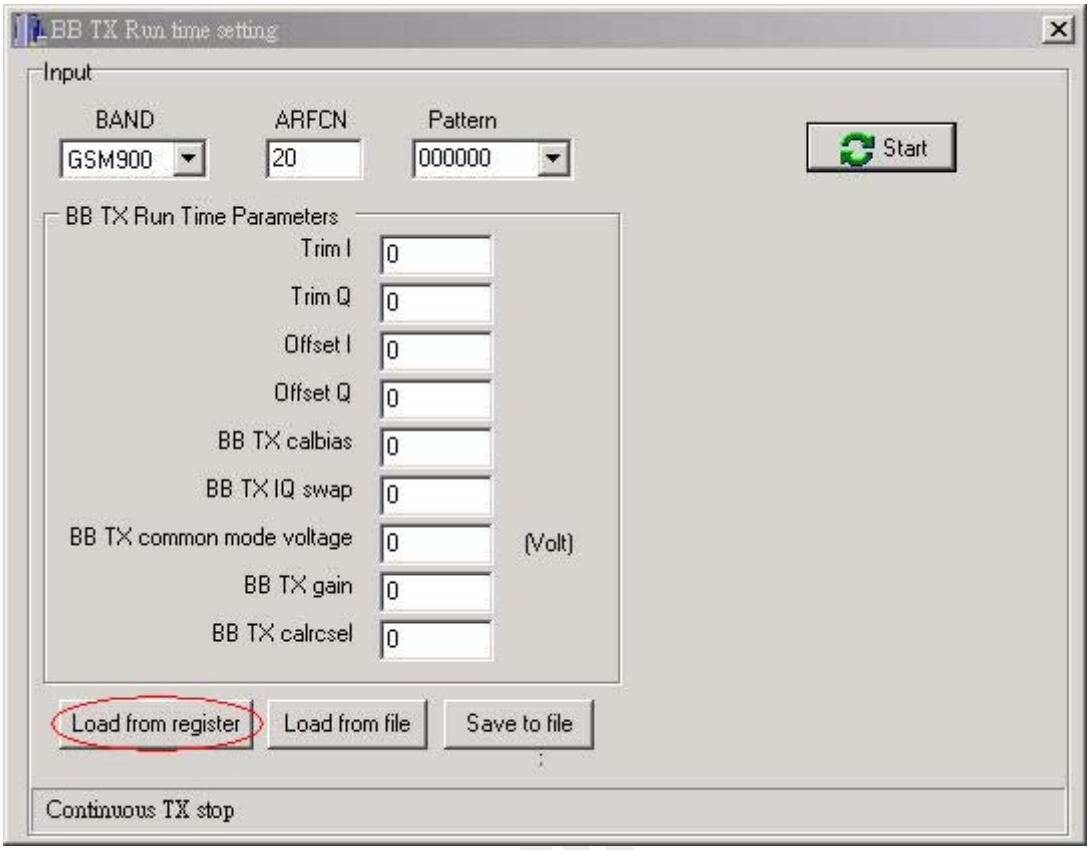

Figure 50 Click [Load from register] button to read BB TX run time parameter from register

User can click [Load from file] button to read BB TX run time parameter from file and click [Save to file] button to write BB TX run time parameter to file.

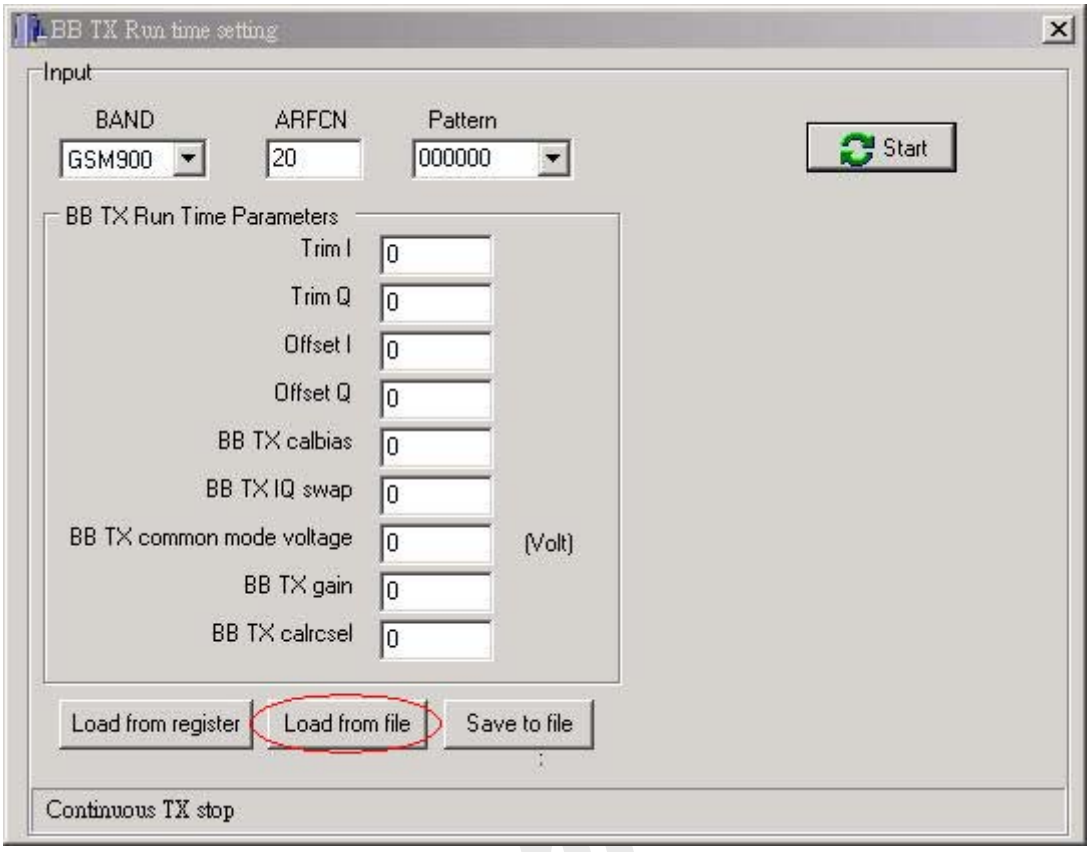

Figure 51 Click [Load from file] button to read BB TX run time parameter from file

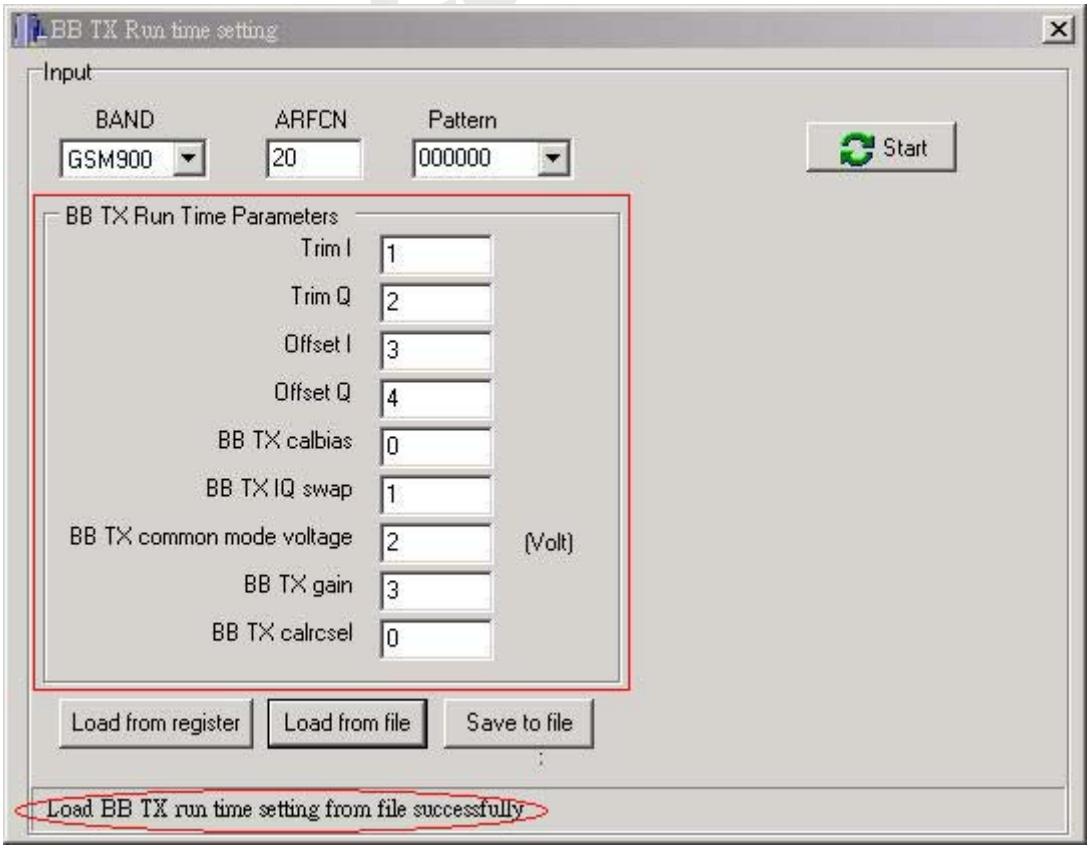

Figure 52 BB TX run time parameter result

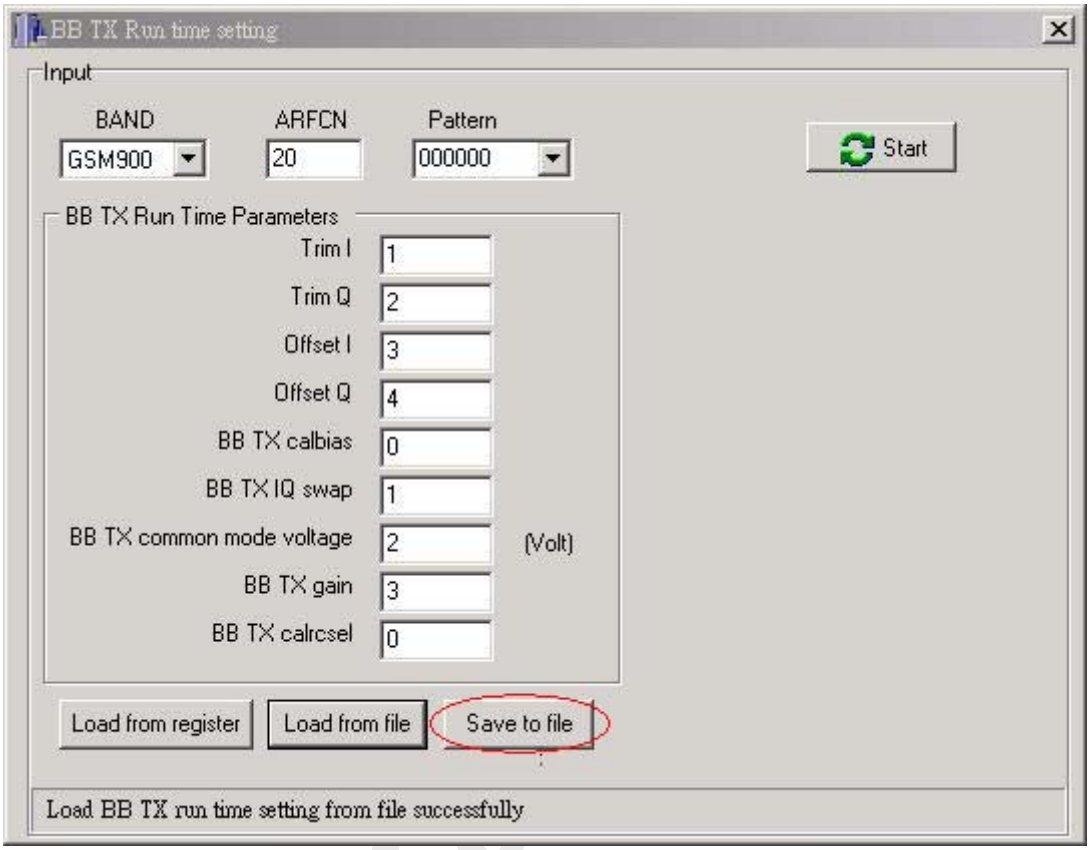

Figure 53 Click [Save to file] button to save BB TX run time parameter to file

The following is a template file of BB TX run time parameter. User will get the text file after saving BB TX run time parameter to file.

[BB TX Run Time Parameters]
Trim I=1
Trim Q=2
Offset I=3
Offset Q=4
BB TX calbias=0
BB TX IQ swap=1
BB TX common mode voltage=2
BB TX gain=3
BB TX calrcsel=0

Note: The meaning of BB TX run time parameters is as follows.

- Trim I: this field is used to control gain trimming of I-channel DAC in BB TX mixed-signal module.
- Trim Q: this field is used to control gain trimming of Q-channel DAC in BB TX mixed-signal module.
- Offset I: this field is used to control value of offset cancellation for I-channel DAC in BB TX mixed-signal module.
- Offset Q: this field is used to control value of offset cancellation for Q-channel DAC in BB TX

mixed-signal module.

- BB TX Calbias: this field is used for control of biasing current in BBTX mixed-signal module.
- BB TX IQSwap: this field is used for control of I/Q swapping. When the bit is set to '1', phase on I/Q plane will rotate inverse direction
- BB TX common voltage gain: this field is used to control common voltage in TX mixed-signal module. It is coded in 2's complement with maximum 3 and minimum -4.
- BB TX gain: this filed is used to control gain of DAC in TX mixed-signal module. It is coded in 2's complement with maximum 3 and minimum -4.
- BB TX calrcsel: This filed is used to select cutoff frequency of smoothing filter in TX mixed-signal module.It is coded in 2's complement with maximum 3 and minimum -4.

3.2.5 TX level and profile

This operation is used for fine tune TX configuration and profiles. Power Amplifier is turned on in this operation and indicated bursts are transmitted. User can input Band, ARFCN, TSC, PCL (Power control level), AFC DAC value and chose burst type and then click [Start] button to test TX power level. MS will start to transmit RF signal with the parameters set by user after MS get the command from META. RF engineer can measure the transmitted power of MS by Agilent 8960 or other measurement instrument.

Note: The meaning of BB TX parameters is as follows.

- APC bat low voltage: This field is used to setup APC's voltage compensation threshold under low battery voltage. The unit is voltage.
- APC bat high voltage: This field is used to setup APC's voltage compensation threshold under high battery voltage. The unit is voltage.
- APC bat low temperature: This field is used to setup APC's temperature compensation threshold under low battery temperature. The unit is degree.
- APC bat high temperature: This field is used to setup APC's temperature compensation threshold under high battery temperature. The unit is degree.

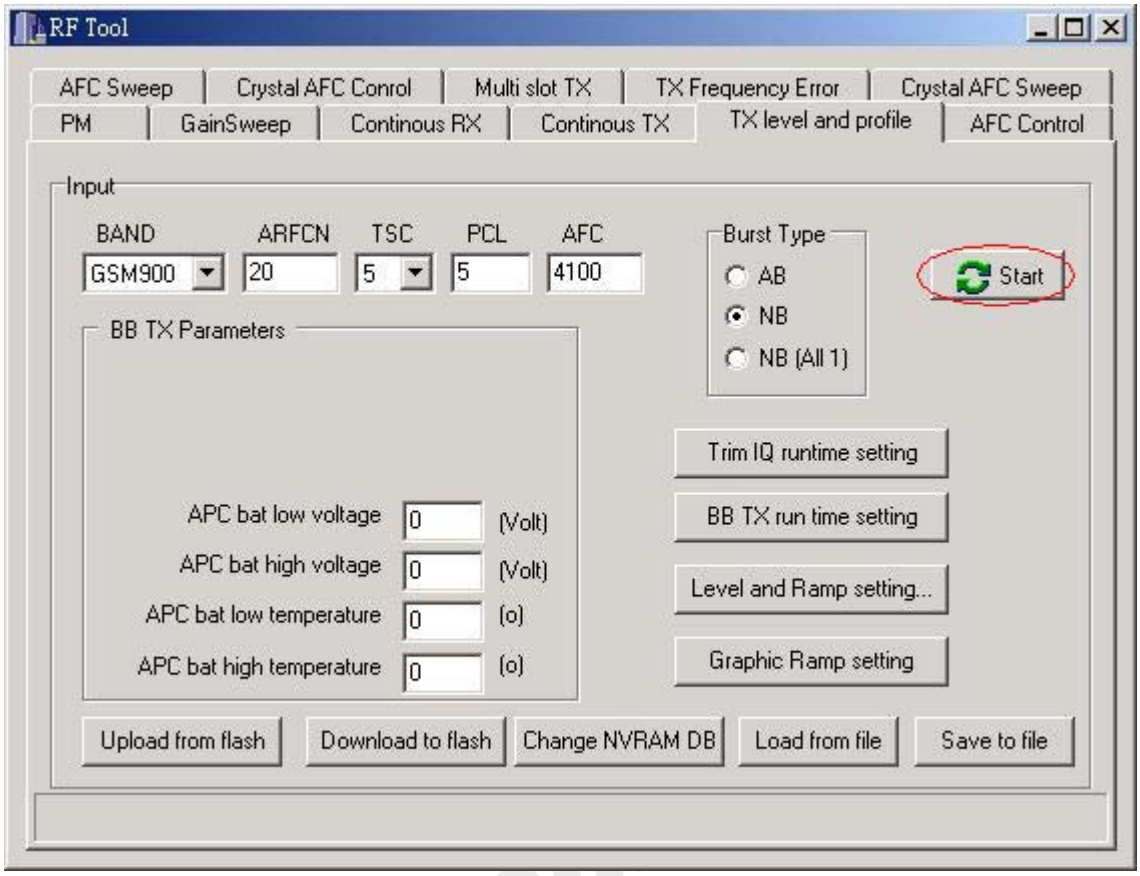

Figure 54 Click [Start] button to start TX level testing.

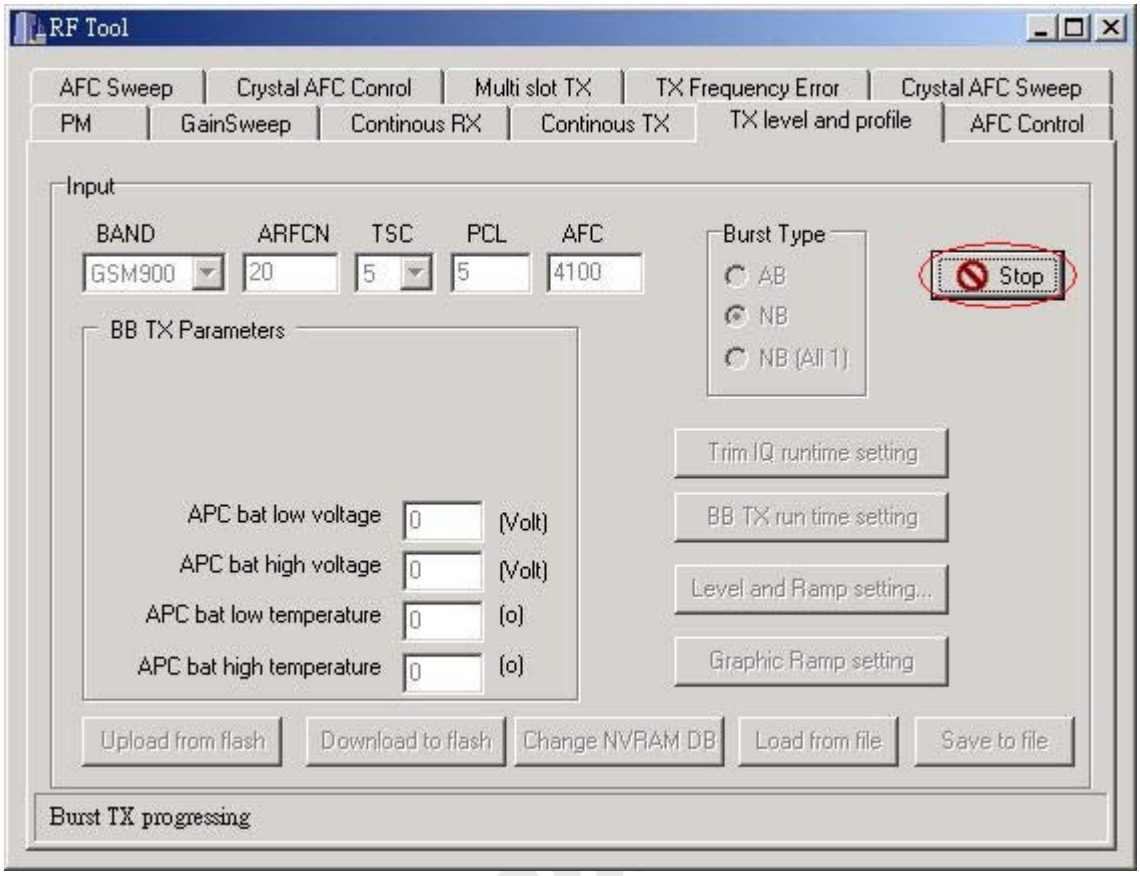

Figure 55 Click [Stop] button to stop TX level testing.

After clicking [Stop] button, the caption of button will change to [Start].

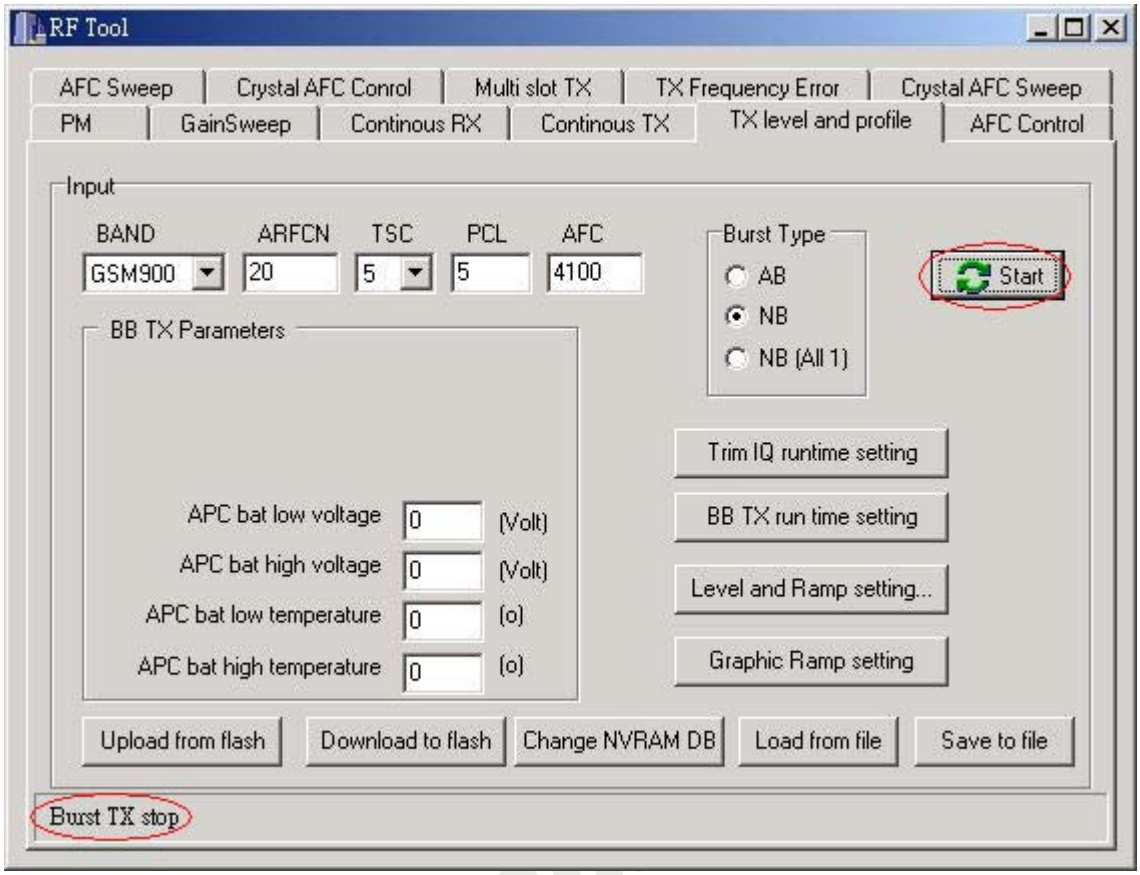

Figure 56 The caption of button will change to [Start]

3.2.5.1 Upload and download BB TX parameter in flash

User can click [Upload from flash] button to read BB TX parameter from flash and click [Download to flash] button to write BB TX parameter to flash.

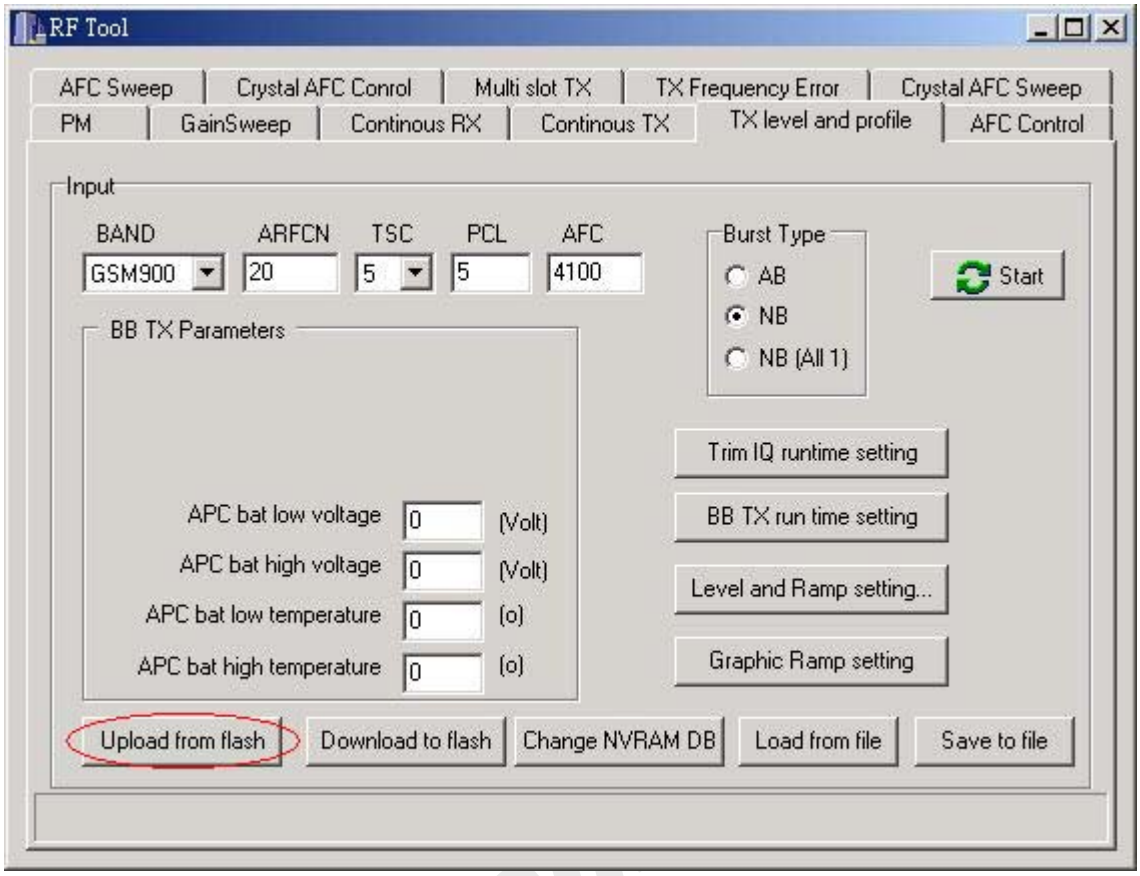

Figure 57 Click [Upload from flash] to read BB TX parameter from flash

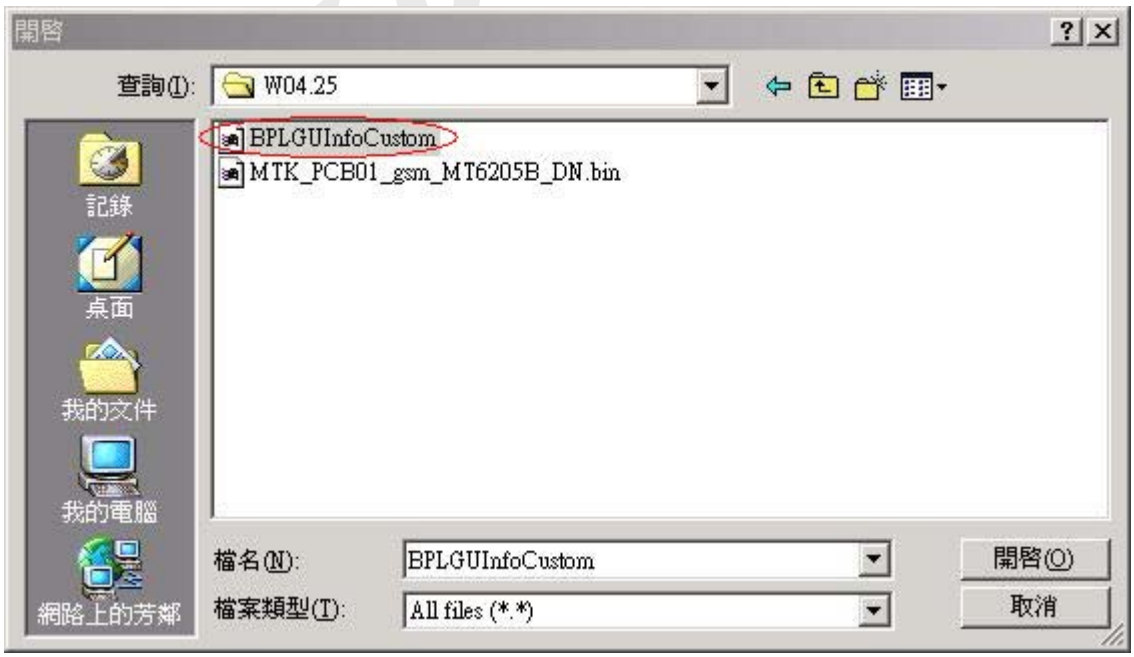

Figure 58 Select NVRAM database file if not selected before

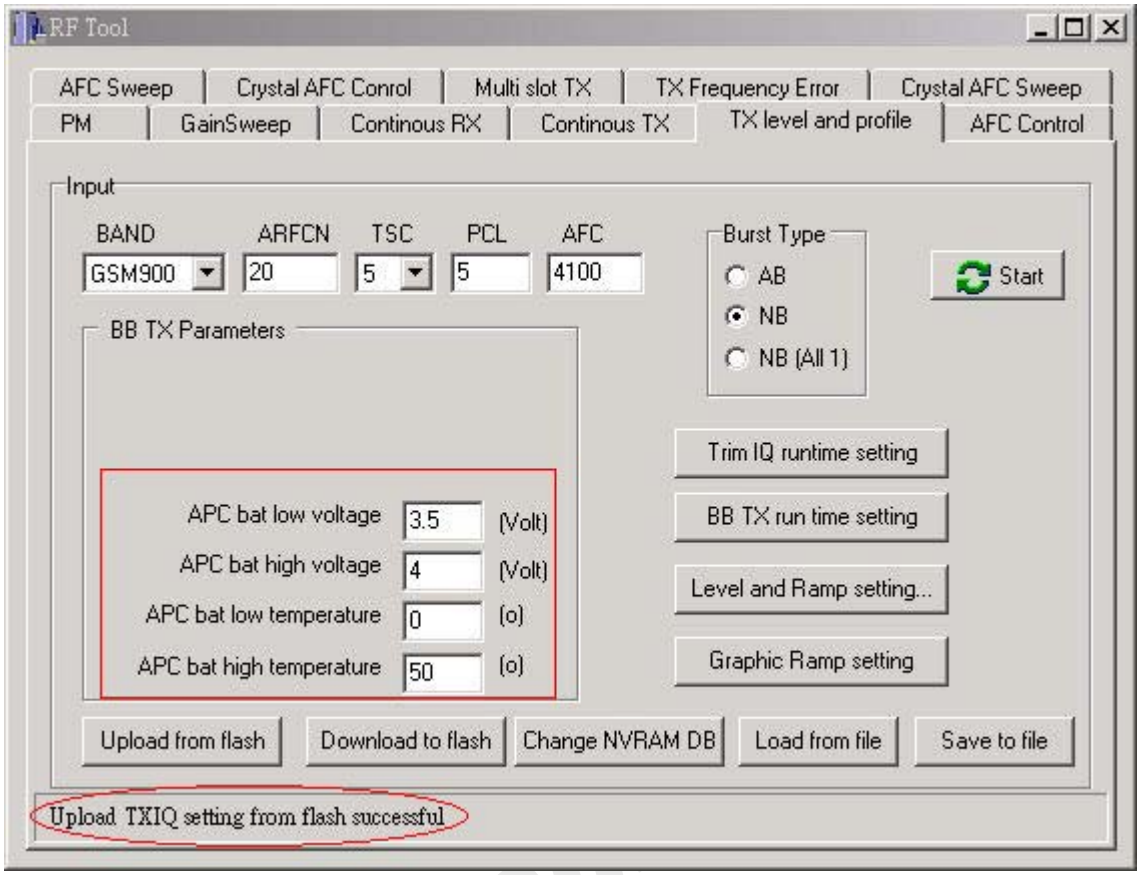

Figure 59 BB TX parameter result

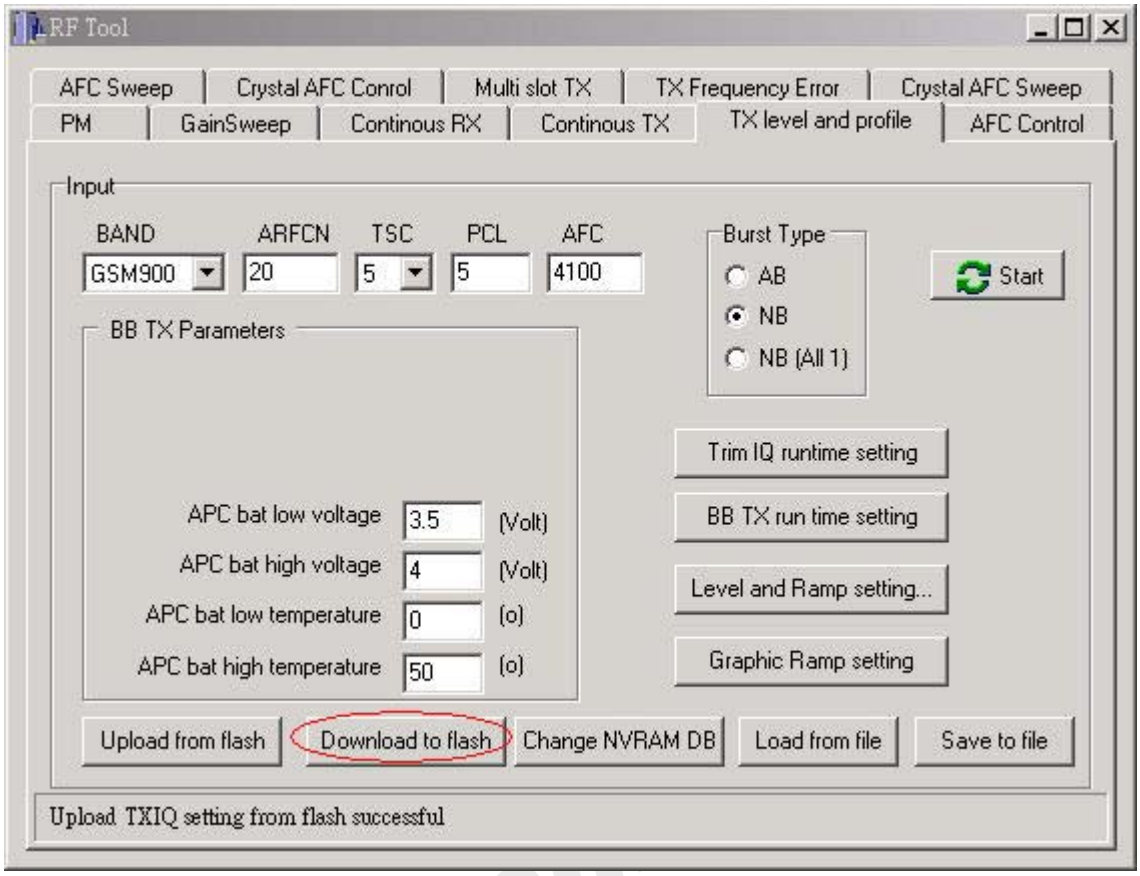

Figure 60 Click [Download to flash] button to download BB TX parameter to flash

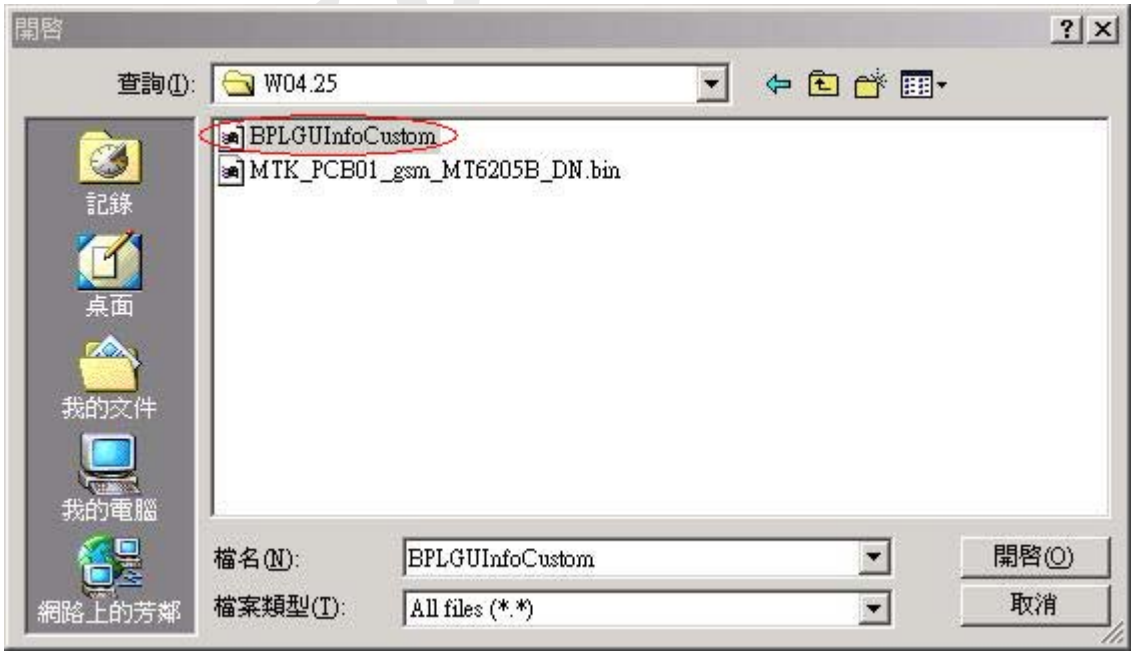

Figure 61 Select NVRAM database file if not selected before

If User wants to change NVRAM database file, he can click [Change NVRAM DB] button.

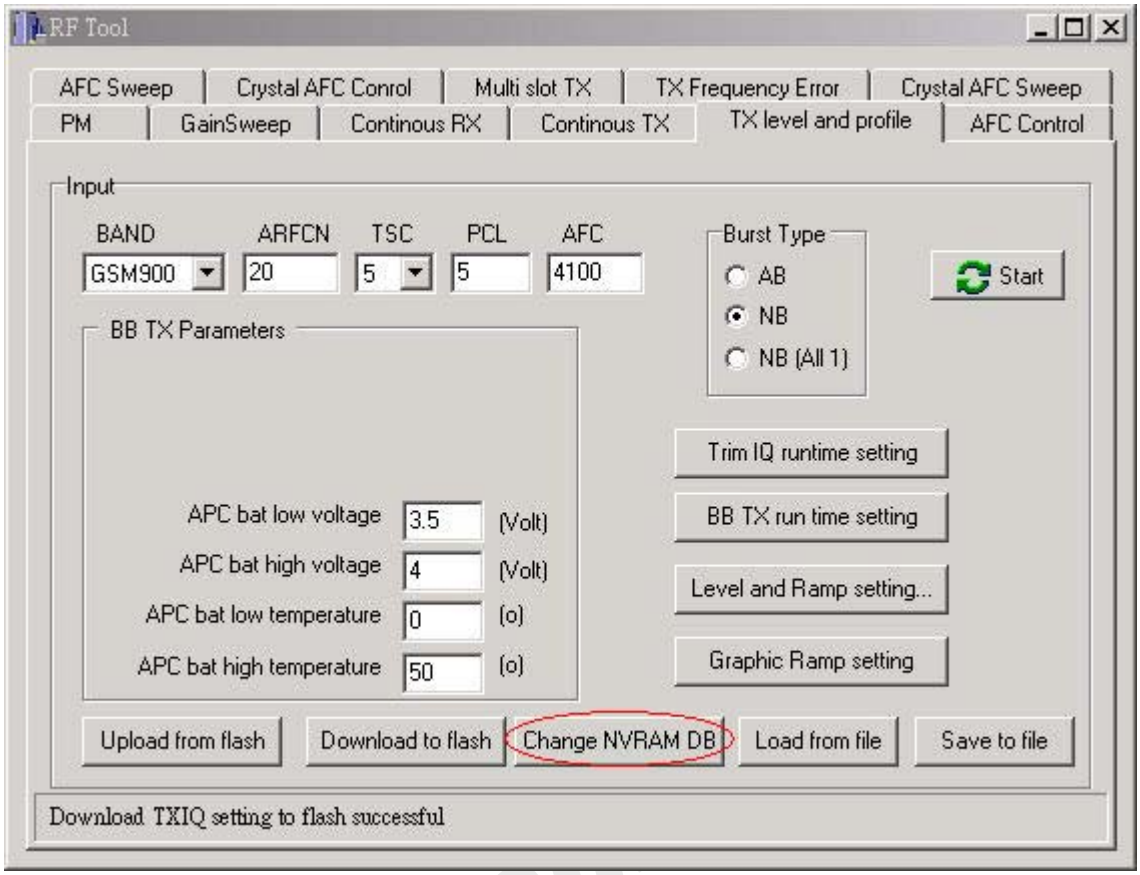

Figure 62 Click [Change NVRAM DB] button to change NVRAM database file

3.2.5.2 Read and write BB TX parameter in file

User can click [Load from file] button to read BB TX parameter from file and click [Save to file] button to write BB TX parameter to file.

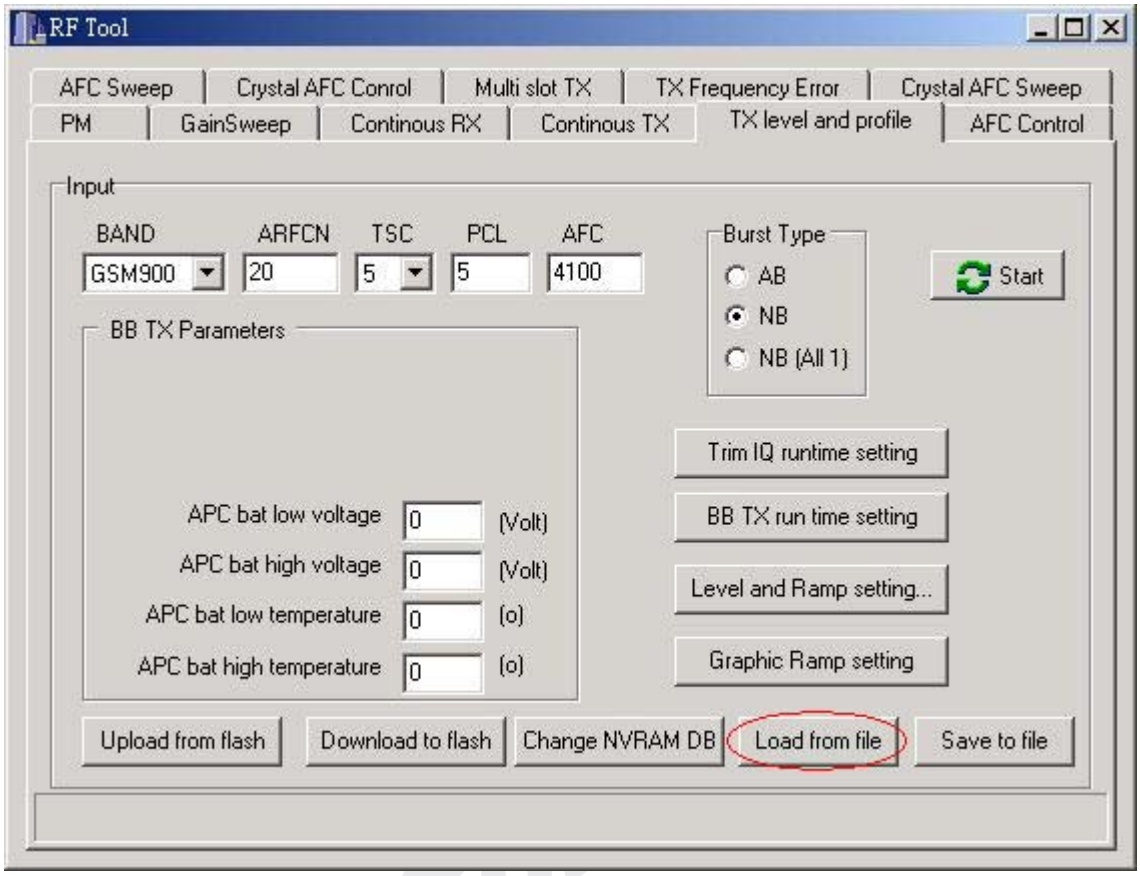

Figure 63 Click [Load from file] button to read BB TX parameter from file

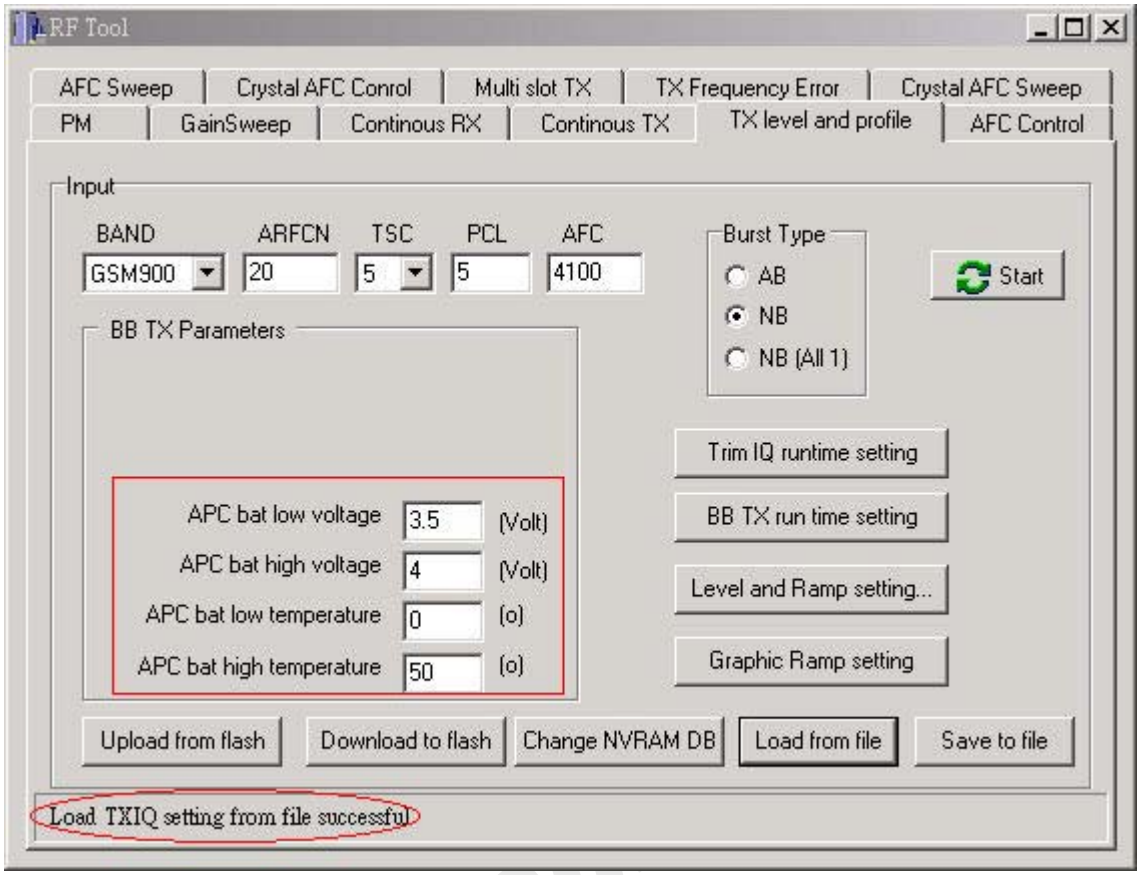

Figure 64 BB TX parameter result

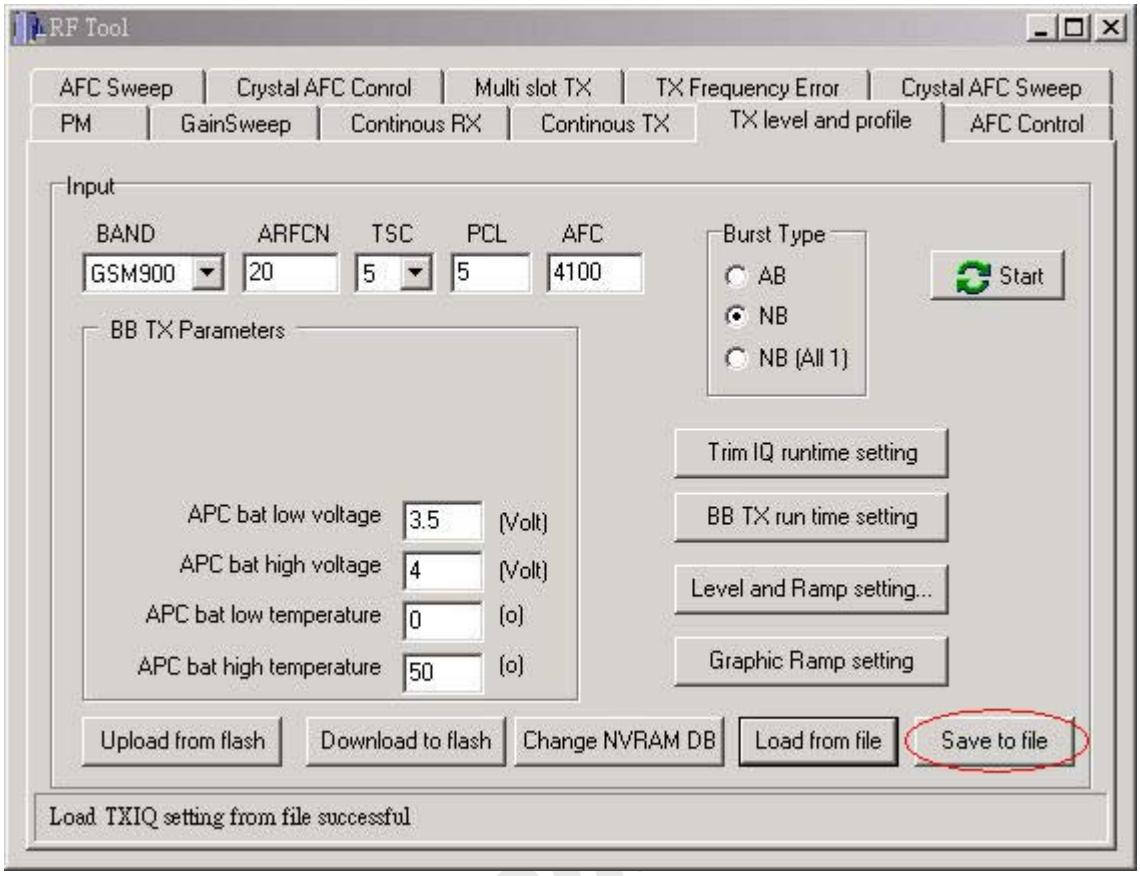

Figure 65 Click [Save to file] button to save BB TX parameter to file

The following is a template file of BB TX parameter. User will get the text file after saving BB TX parameter to file.

[BB TX Parameters]
APC bat low voltage=3.5
APC bat high voltage=4
APC bat low temperature=0
APC bat high temperature=50

3.2.5.3 Trim IQ run time setting

User can click [Trim IQ run time setting] button to show trim IQ and offset IQ run time setting window.

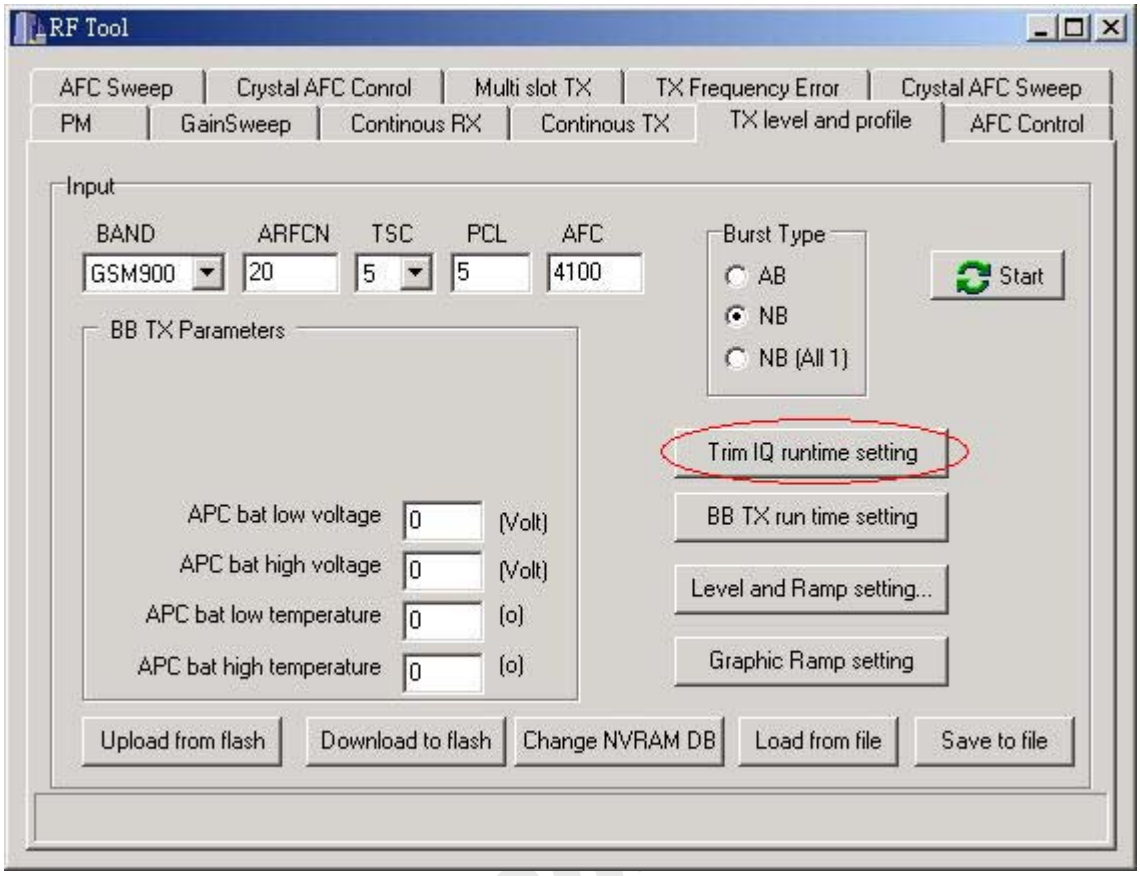

Figure 66 Click [Trim IQ run time setting] button to enter trim IQ and offset IQ run time setting window

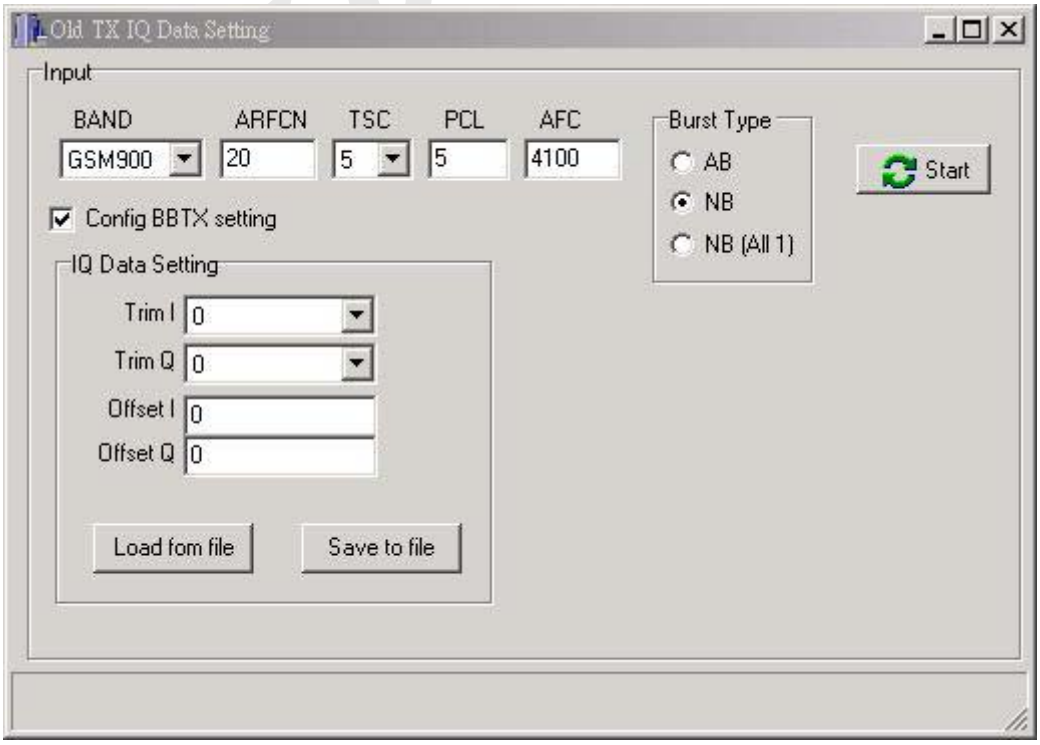

Figure 67 Trim IQ and offset IQ run time setting window

Trim IQ and offset IQ run time setting window is used for user to tune trim IQ and offset IQ. Power amplifier is turned on in this operation. User can input band, ARFCN, TSC (training sequence code), PCL (power control level), AFC DAC value, trim IQ, offset IQ and chose burst type and then click [Start] button to start TX test. After starting TX, the caption of the button will change to [Stop]. User can click [Stop] button to stop it.

If Config BBTX setting checkbox is checked, then Trim IQ and offset IQ value will be set to register, otherwise, Trim IQ and offset IQ value will not be set to register.

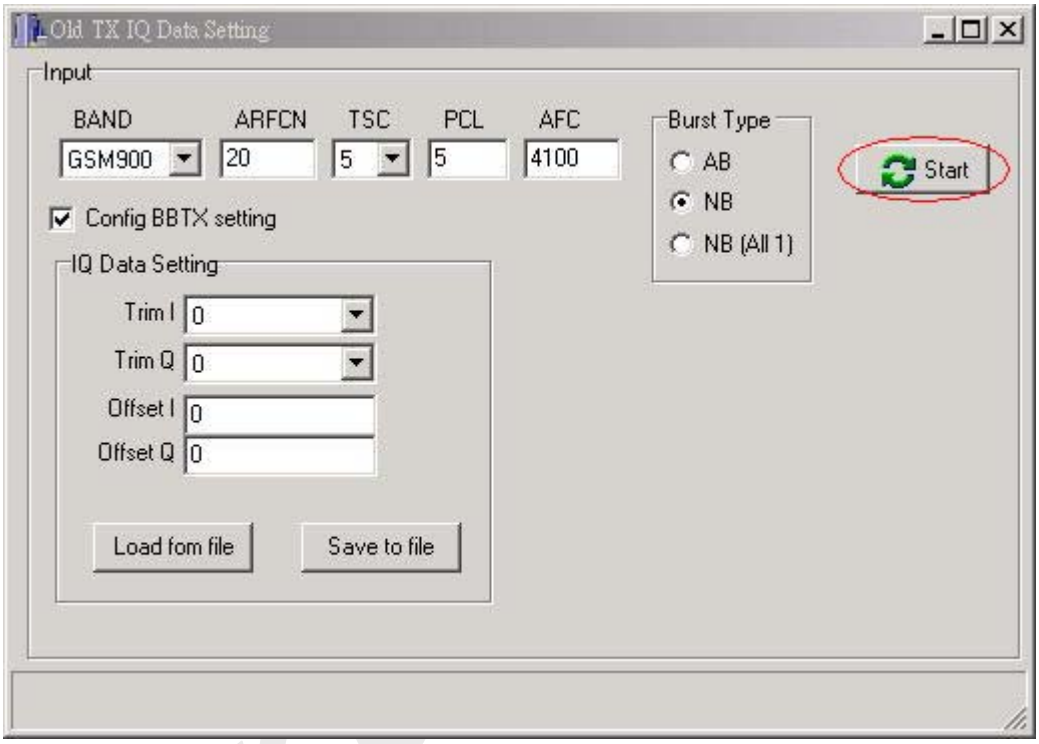

Figure 68 Click [Start] button to start TX level testing

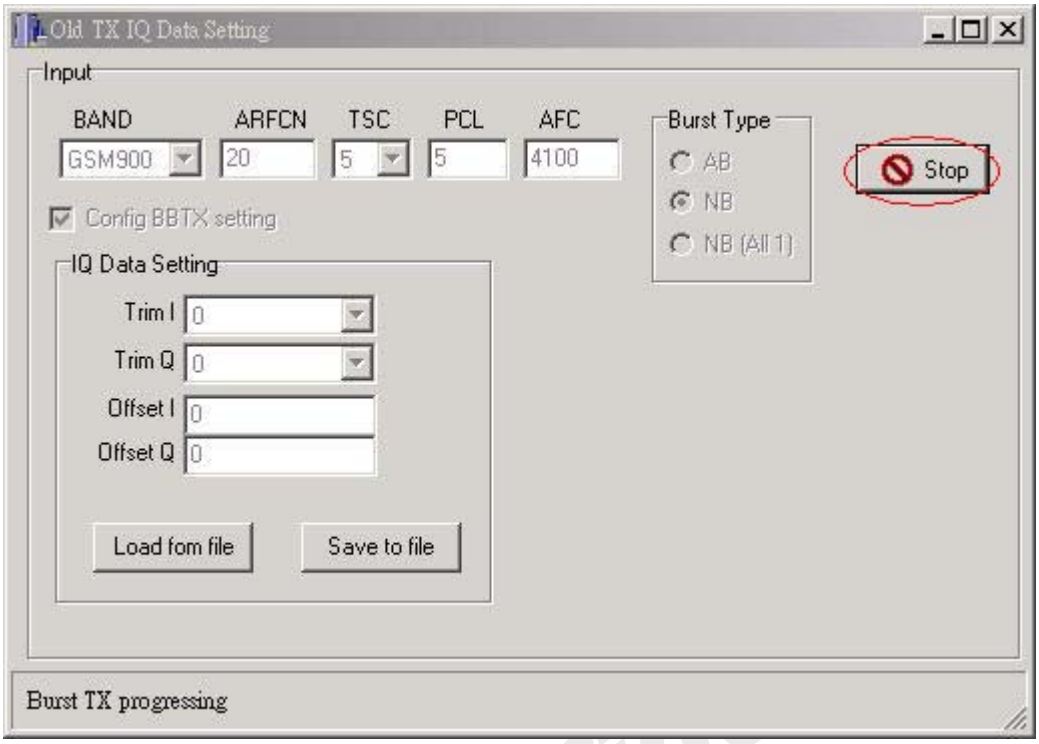

Figure 69 Click [Stop] button to stop testing

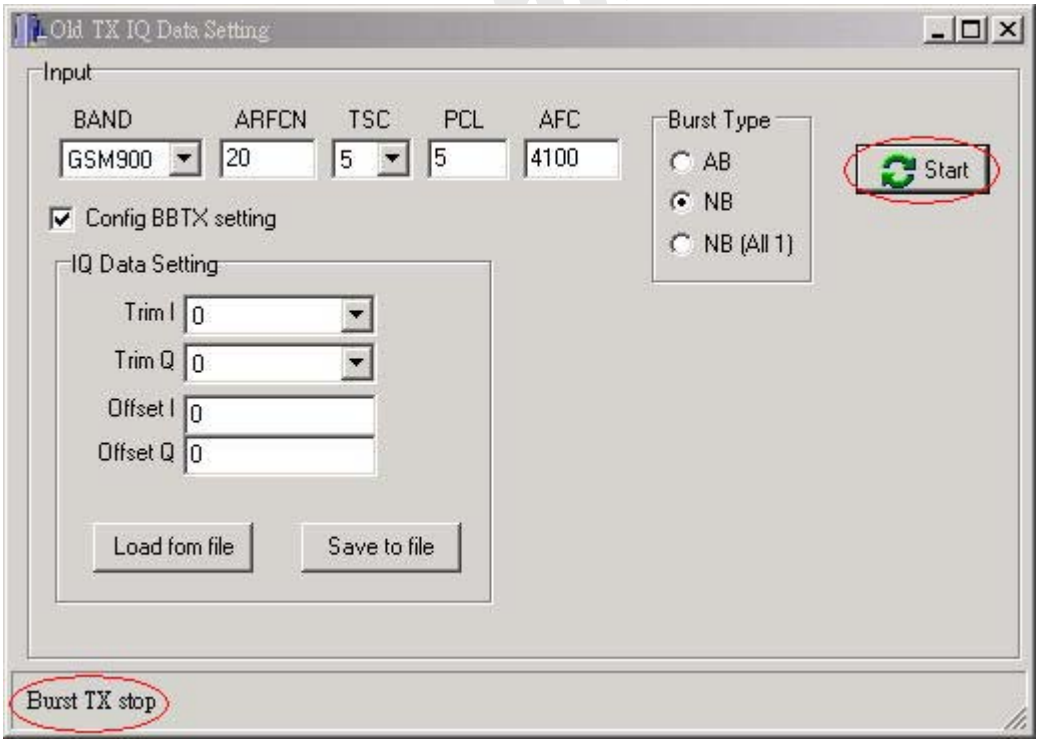

Figure 70 The caption of button will change to [Start]

User can click [Load from file] to load Trim IQ and offset IQ value from text file and click [Save to file] button to save Trim IQ and offset IQ to text file.

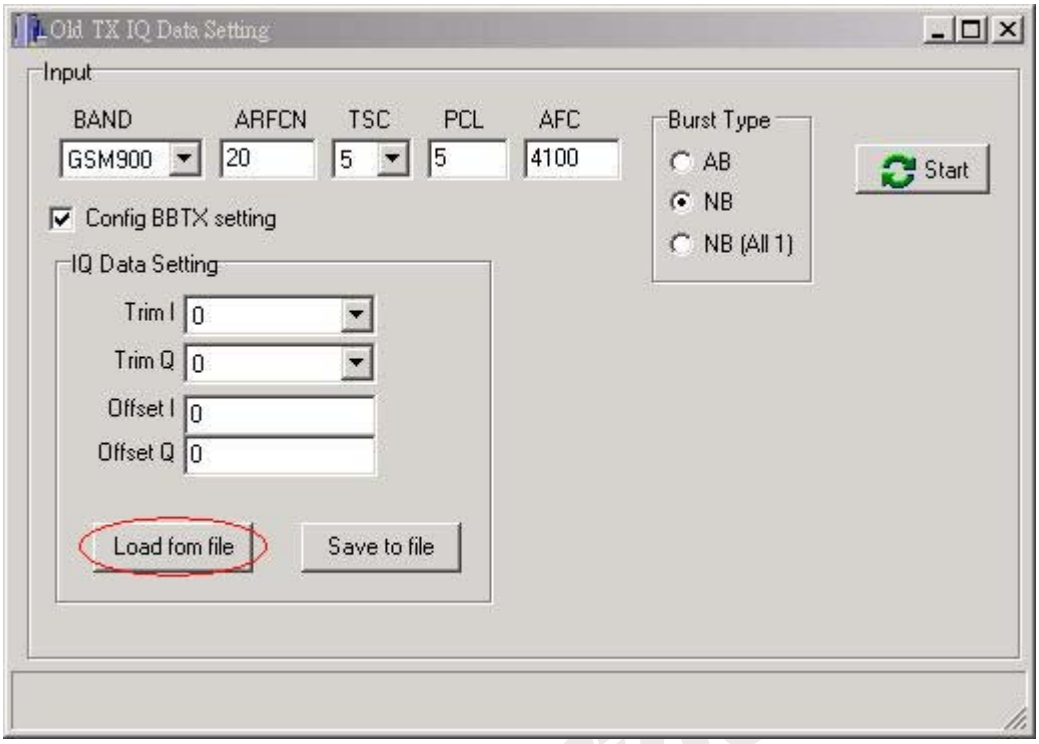

Figure 71 Click [Load from file] button to read Trim IQ and Offset IQ from file

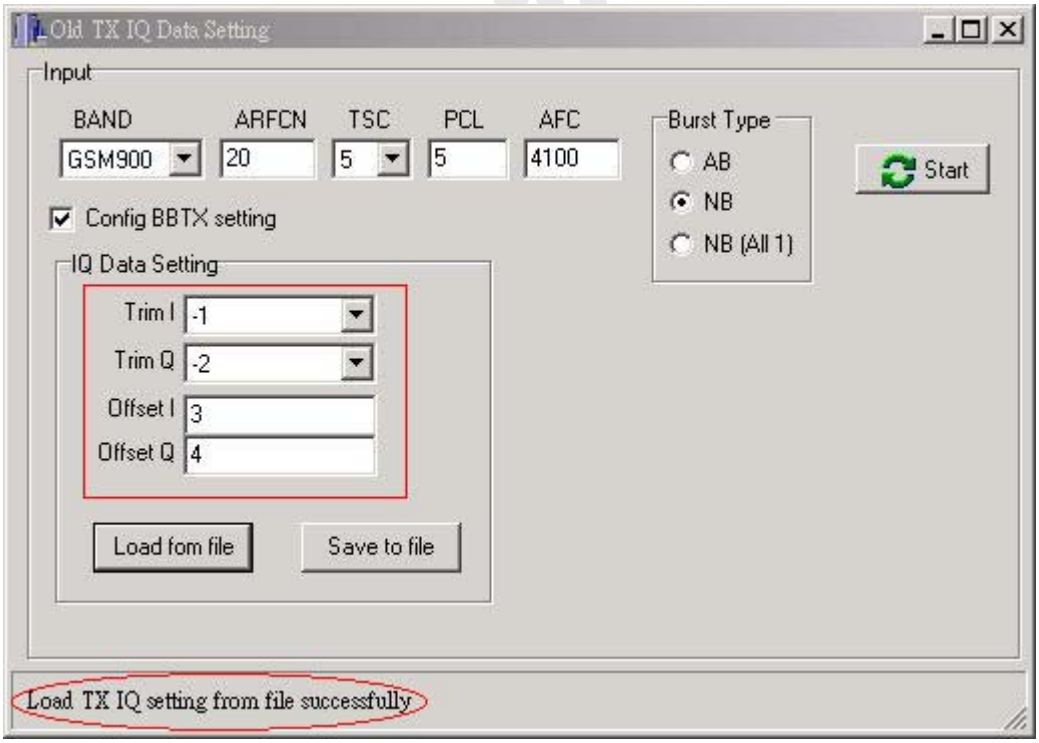

Figure 72 Trim IQ and Offset IQ result

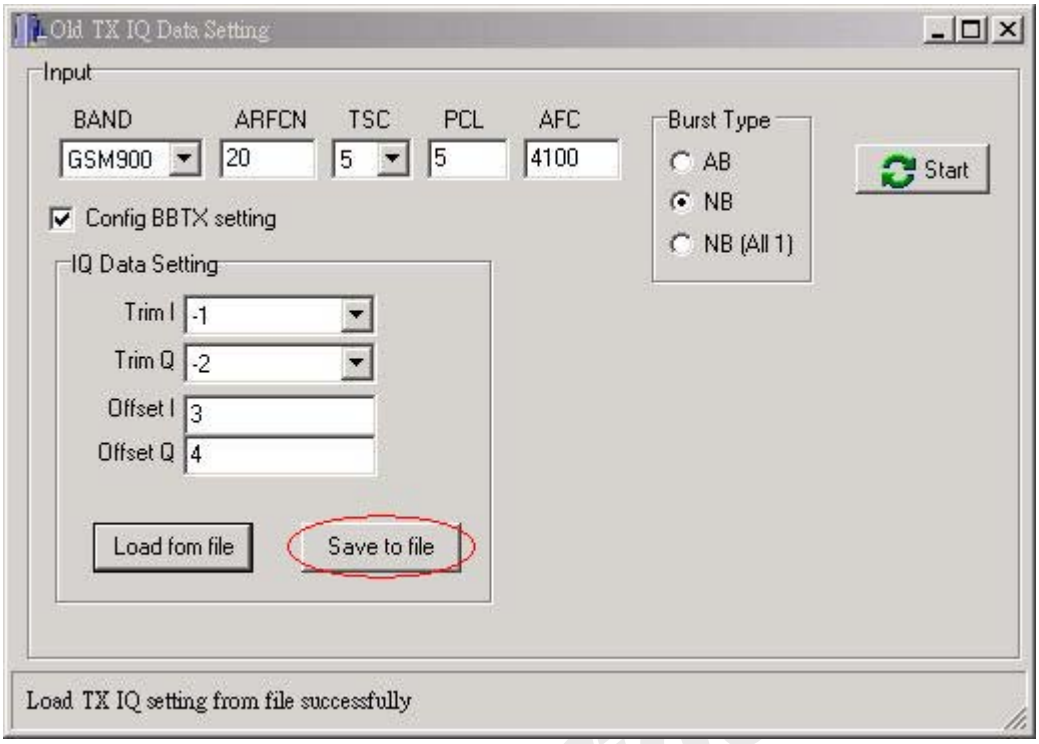

Figure 73 Click [Save to file] button to save Trim IQ and Offset IQ to file

The following is a template file of IQ data setting file. User will get the text file after saving IQ data setting to file.

[TX IQ setting]
Trim I=-1
Trim Q=-2
Offset I=3
Offset Q=4

Note: The meaning of Trim I, Trim Q and Offset I, Offset Q is as follows.

- Trim I: The field is used to control gain trimming of I-channel DAC in BBTX mixed-signal module.
- Trim Q: The field is used to control gain trimming of Q-channel DAC in BBTX mixed-signal module.
- Offset I: The field is used to control value of offset cancellation for I-channel DAC in TX mixed-signal module.
- Offset Q: The field is used to control value of offset cancellation for Q-channel DAC in TX mixed-signal module.

3.2.5.4 BB TX run time setting

User can click [BB TX run time setting] button to show BB TX run time setting window.

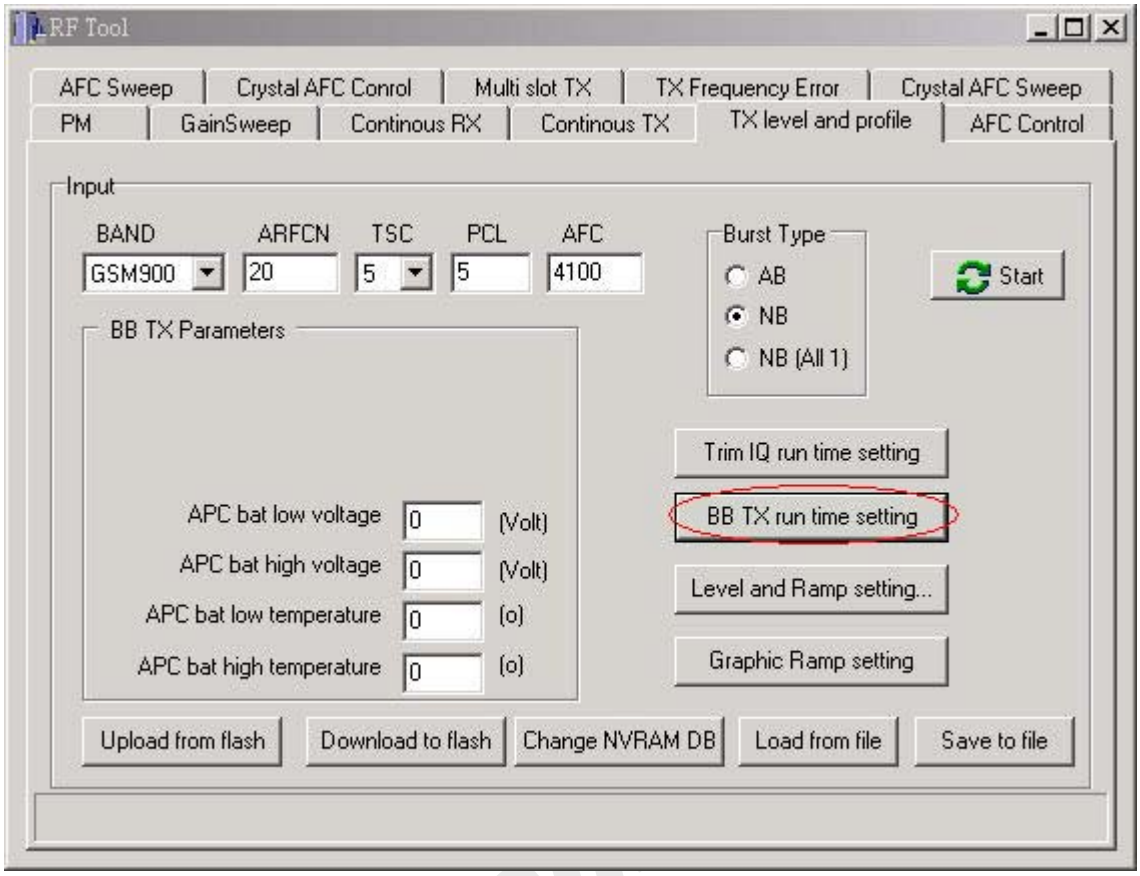

Figure 74 Click [BB TX run time setting] button to show BB TX run time setting window

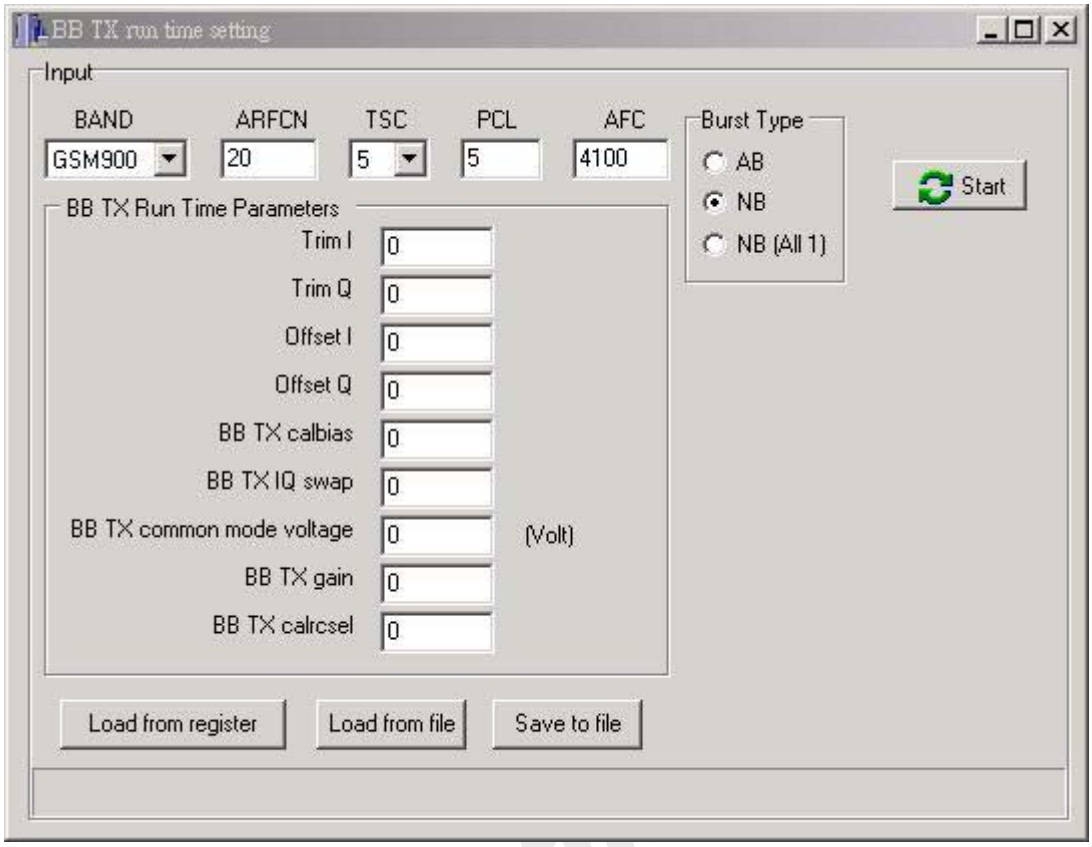

Figure 75 BB TX run time setting window

BB TX run time setting window is used for user to adjust BB TX parameter. Power amplifier is turned on in this operation. User can input band, ARFCN, TSC (training sequence code), PCL (power control level), AFC DAC value, BB TX run time parameters and chose burst type and then click [Start] button to start TX level test. After starting TX level, the caption of the button will change to [Stop]. User can click [Stop] button to stop it.

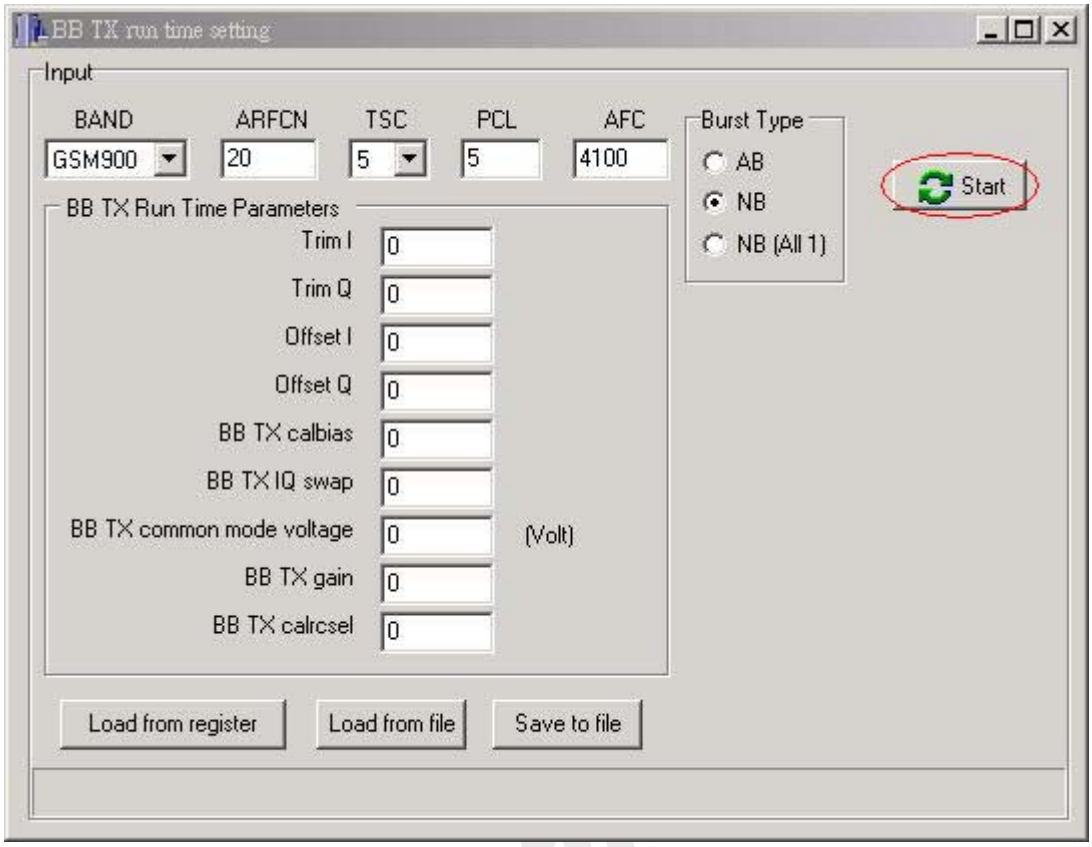

Figure 76 Click [Start] button to start TX level testing

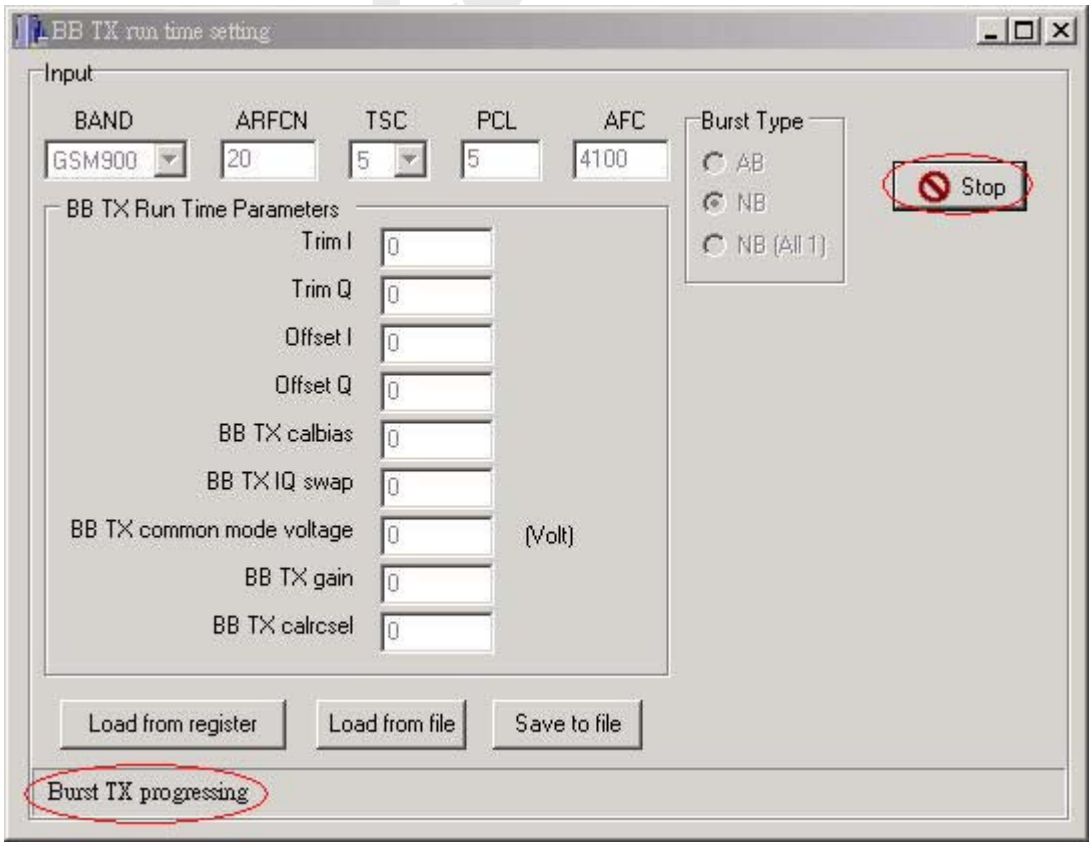

Figure 77 Click [Stop] button to stop testing

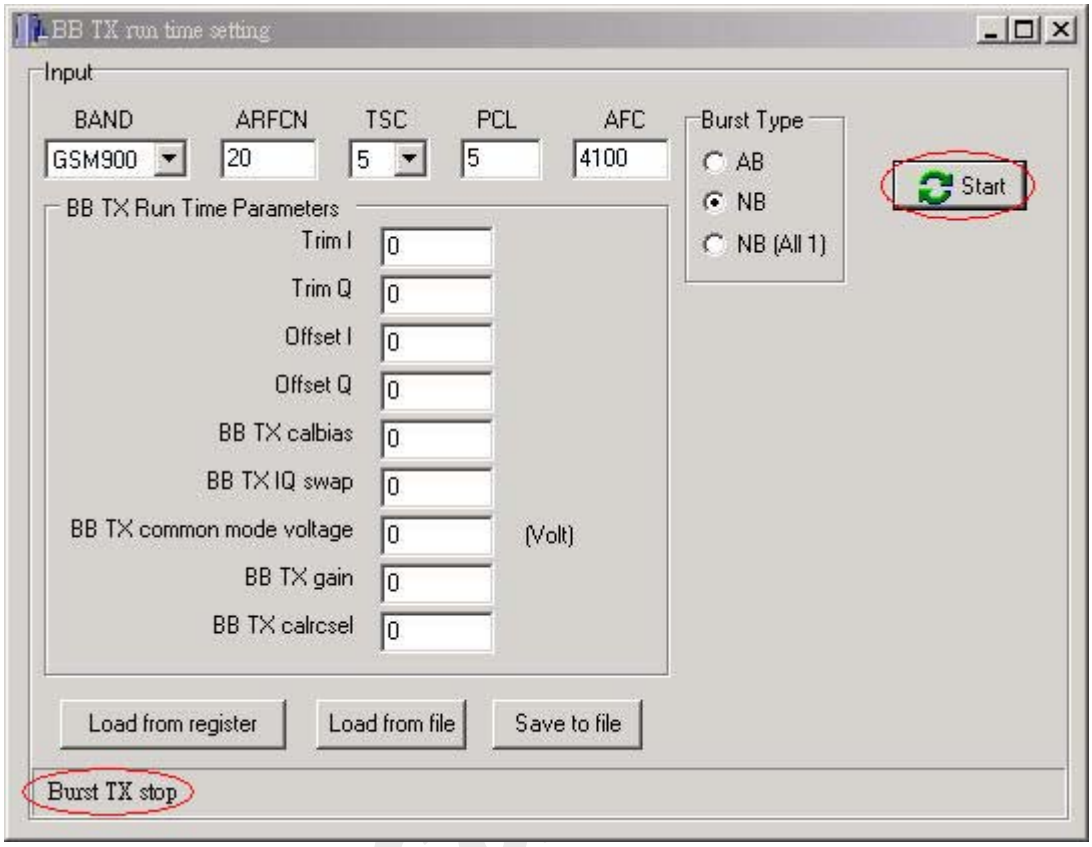

Figure 78 The caption of button will change to [Start]

User can click [Load from register] button to load BB TX run time setting from register.

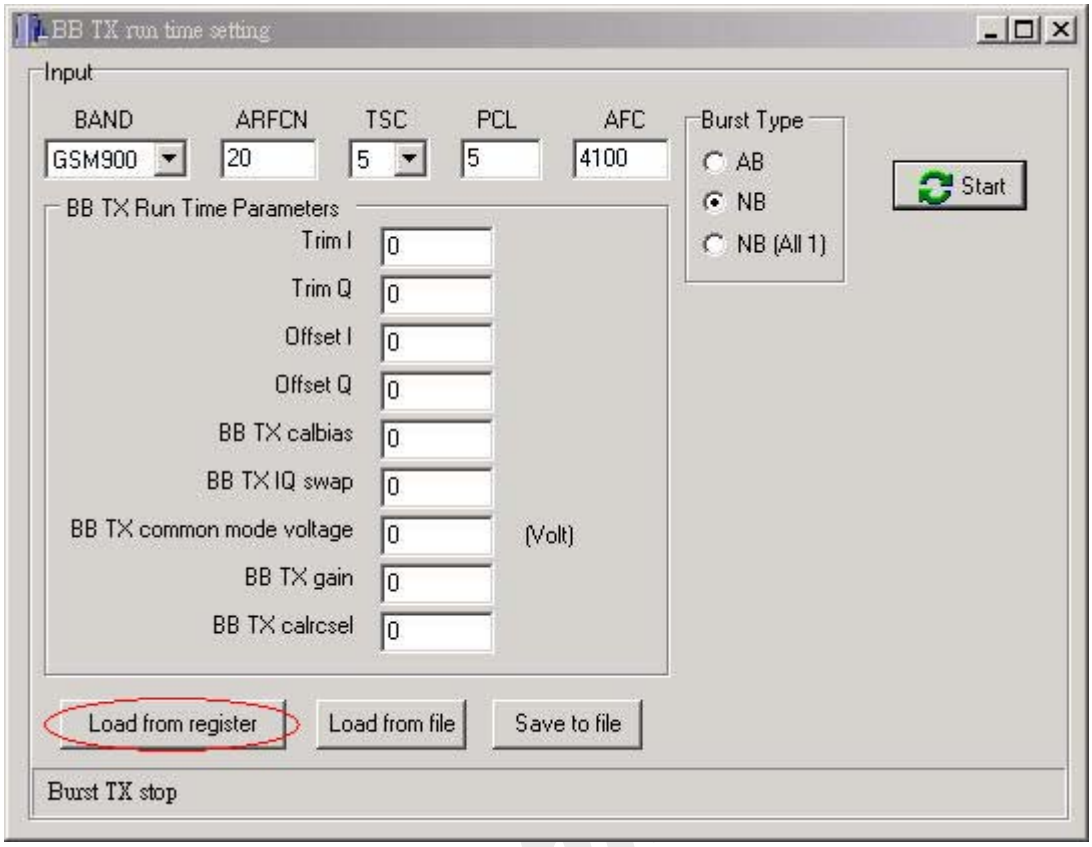

Figure 79 Click [Load from register] to read BB TX run time parameter from register

User can click [Load from file] button to read BB TX run time parameter from file and click [Save to file] button to write BB TX run time parameter to file.

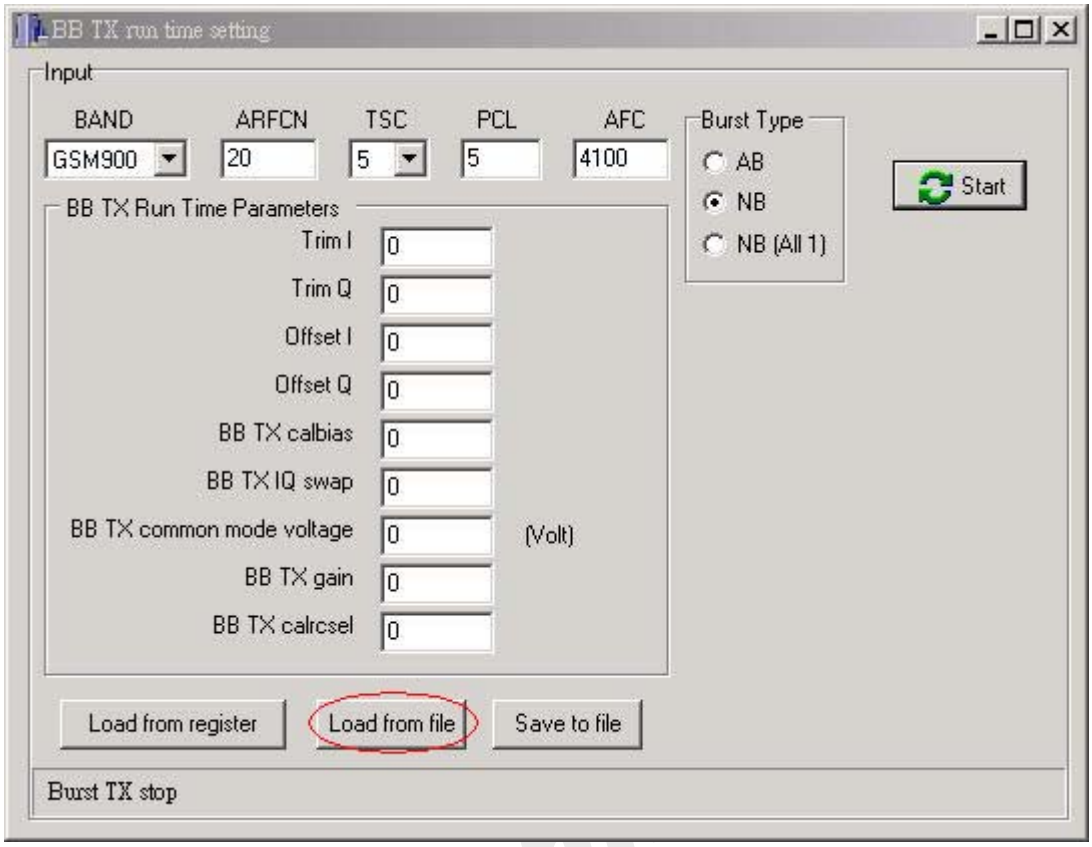

Figure 80 Click [Load from file] to read BB TX run time parameter from file

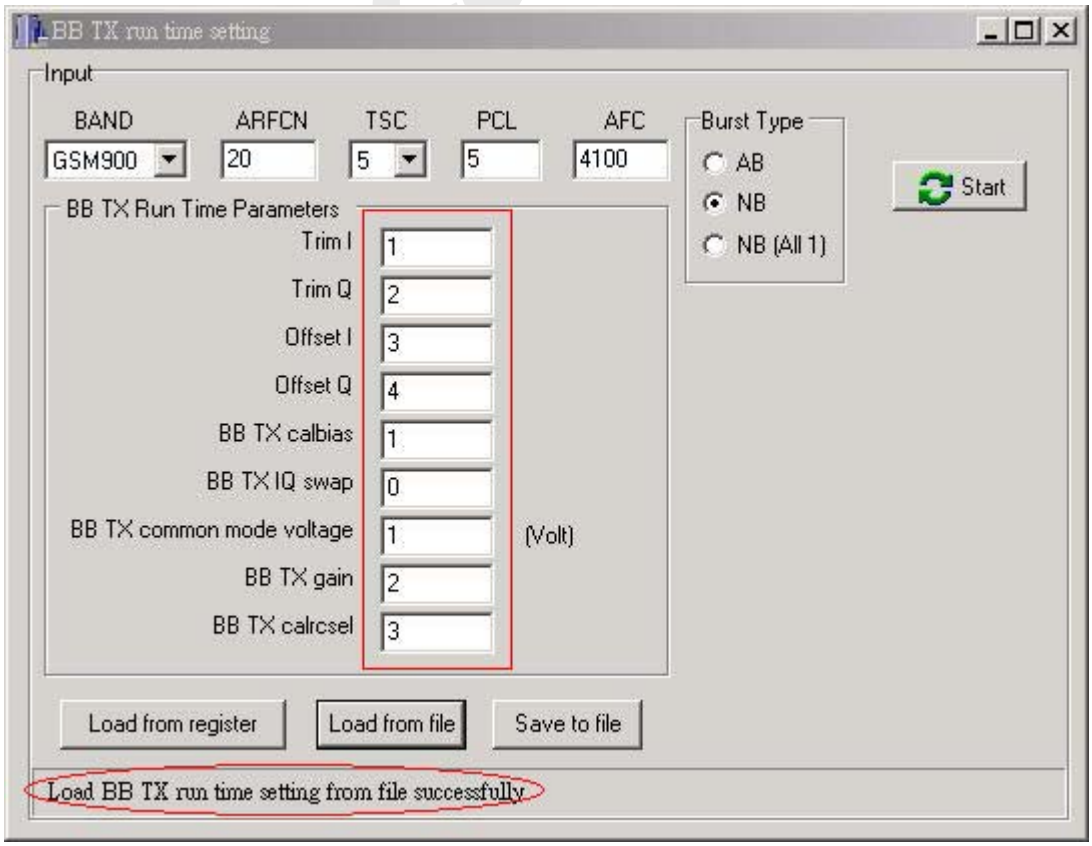

Figure 81 BB TX run time parameter result

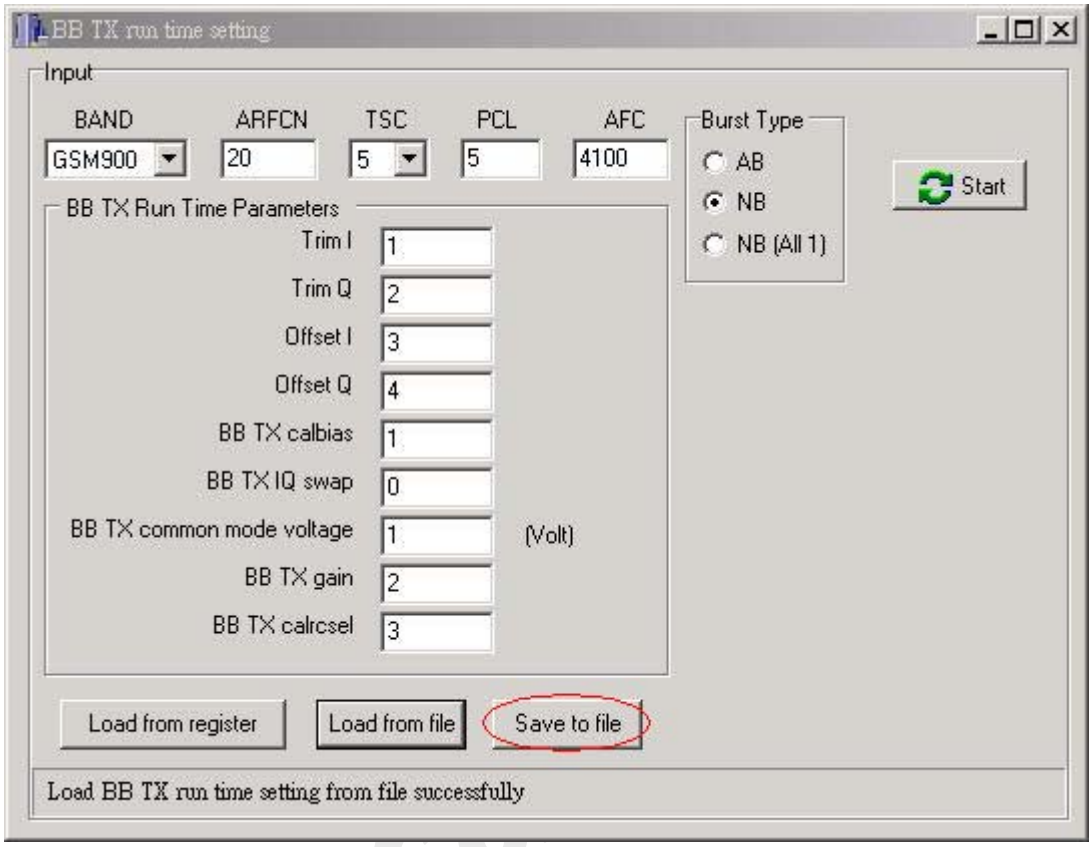

Figure 82 Click [Save to file] to save BB TX run time parameter to file

The following is a template file of BB TX run time parameter file. User will get the text file after saving BB TX run time parameter to file.

[BB TX Run Time Parameters]
Trim I=1
Trim Q=2
Offset I=3
Offset Q=4
BB TX calbias=1
BB TX IQ swap=0
BB TX common mode voltage=1
BB TX gain=2
BB TX calrcsel=3

Note: The meaning of BB TX run time parameters is as follows.

- Trim I: this field is used to control gain trimming of I-channel DAC in BB TX mixed-signal module.
- Trim Q: this field is used to control gain trimming of Q-channel DAC in BB TX mixed-signal module.
- Offset I: this field is used to control value of offset cancellation for I-channel DAC in BB TX mixed-signal module.
- Offset Q: this field is used to control value of offset cancellation for Q-channel DAC in BB TX

mixed-signal module.

- BB TX Calbias: this field is used for control of biasing current in BBTX mixed-signal module.
- BB TX IQSwap: this field is used for control of I/Q swapping. When the bit is set to '1', phase on I/Q plane will rotate inverse direction
- BB TX common voltage gain: this field is used to control common voltage in TX mixed-signal module. It is coded in 2's complement with maximum 3 and minimum -4.
- BB TX gain: this filed is used to control gain of DAC in TX mixed-signal module. It is coded in 2's complement with maximum 3 and minimum -4.
- BB TX calrcsel: This filed is used to select cutoff frequency of smoothing filter in TX mixed-signal module.It is coded in 2's complement with maximum 3 and minimum -4.

3.2.5.5 Level and ramp setting

User can click [level and ramp setting…] button to show the level and ramp window.

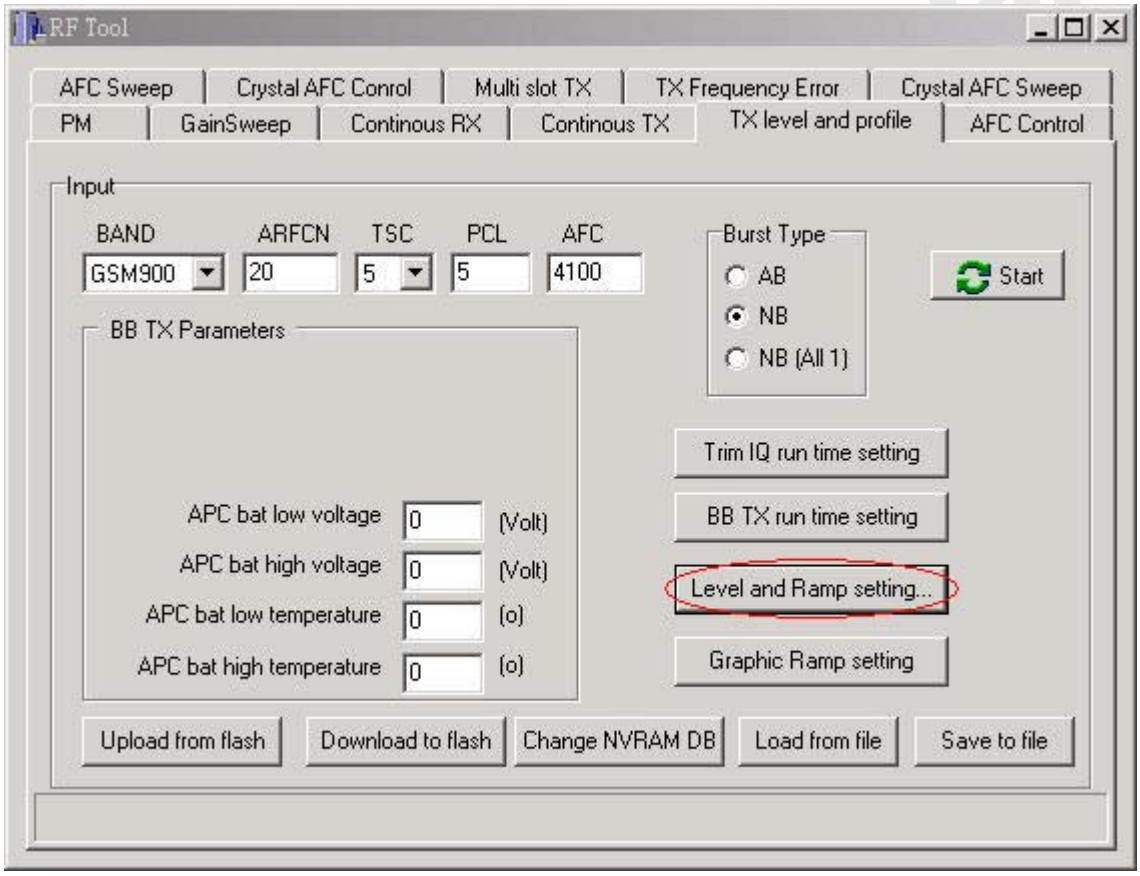

Figure 83 Click [Level and Ramp setting…] button

User can set the TX level (scale factor) for each PCL (power control level). MS will adopt the scale factor for corresponding PCL while transmitting RF. Regarding ramp profile, each PCL could have its own ramp profile.

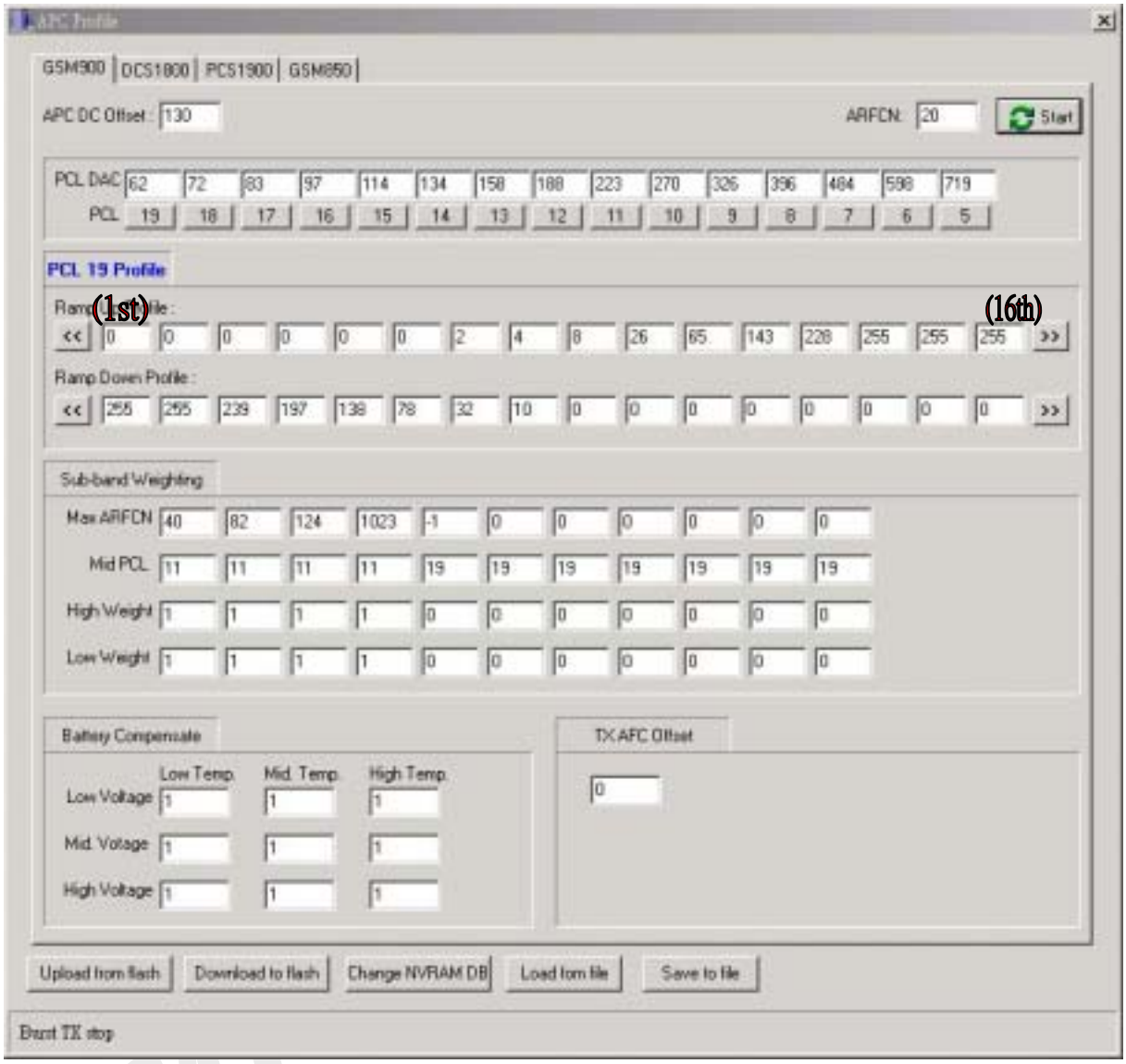

Figure 84 Level and Ramp setting window

Note:

- APC DC offset: the field specifies the pedestal value of the APC unit. The APC D/A converter is powered up biased on the offset value specified by the field.
- Mid PCL : the level below the [Mid PCL] will be multiplied by [low weight], and the level above [Mid PCL] will be multiplied by [high weight].
- high weight : each entry of the ramp profile of level above [Mid PCL] will be multiplied by [high weight].
- low weight : each entry of the ramp profile of level below [Mid PCL] will be multiplied by [low weight].
- Battery compensate: These 3x3 array compensate the APC scaling factor under low/mid/high voltage/temperature.
- TX AFC Offset: the field specifies the crystal TX AFC Offset. Crystal TX AFC DAC = Crystal RX AFC DAC + TX AFC Offset.

User can input APC DAC offset, ARFCN, PCL (power control level) DAC, ramp up/down profile, sub-band weighting and battery compensation value and then press [Start] button to start TX level testing.

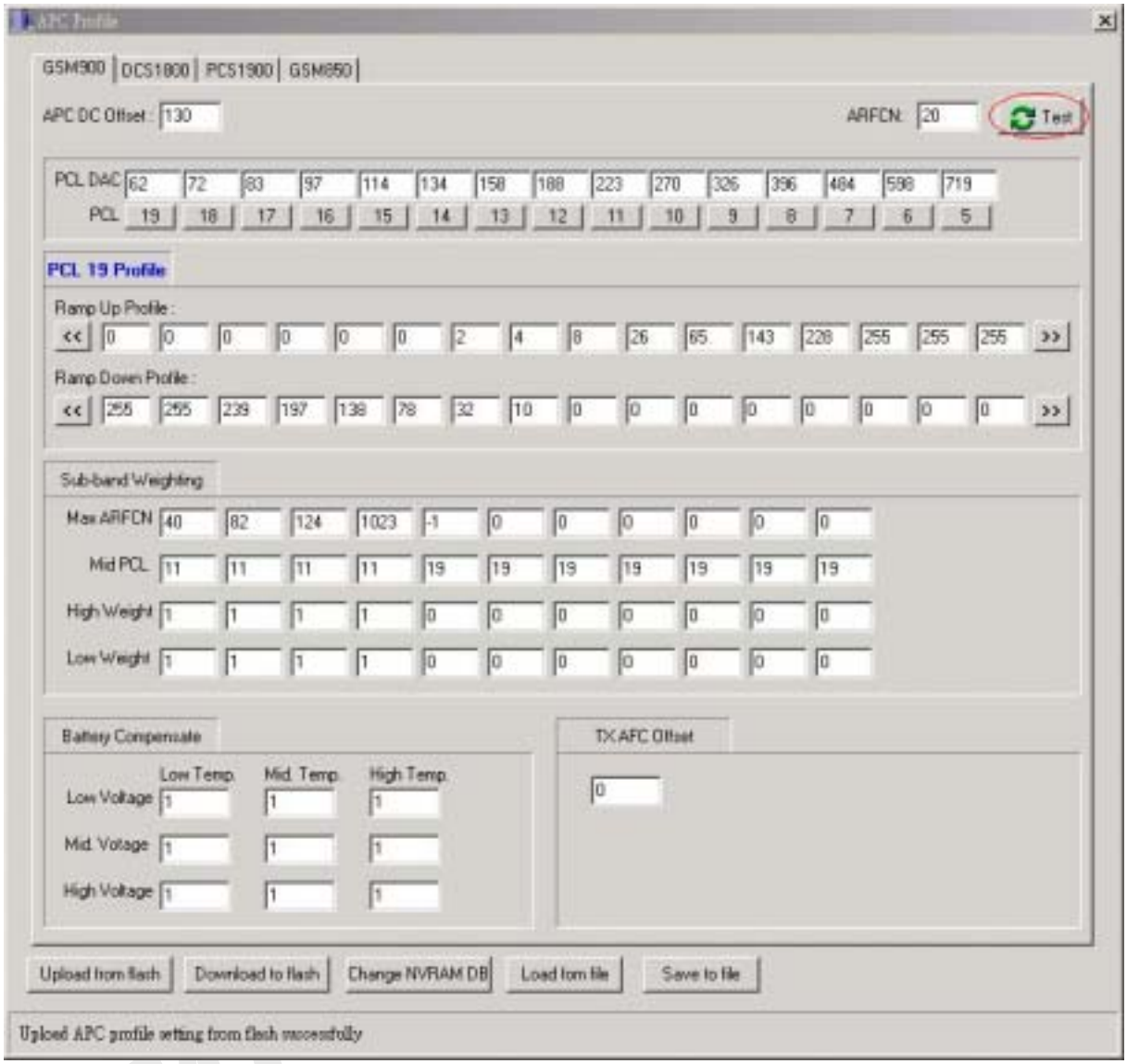

Figure 85 Click [Start] button to start TX level testing

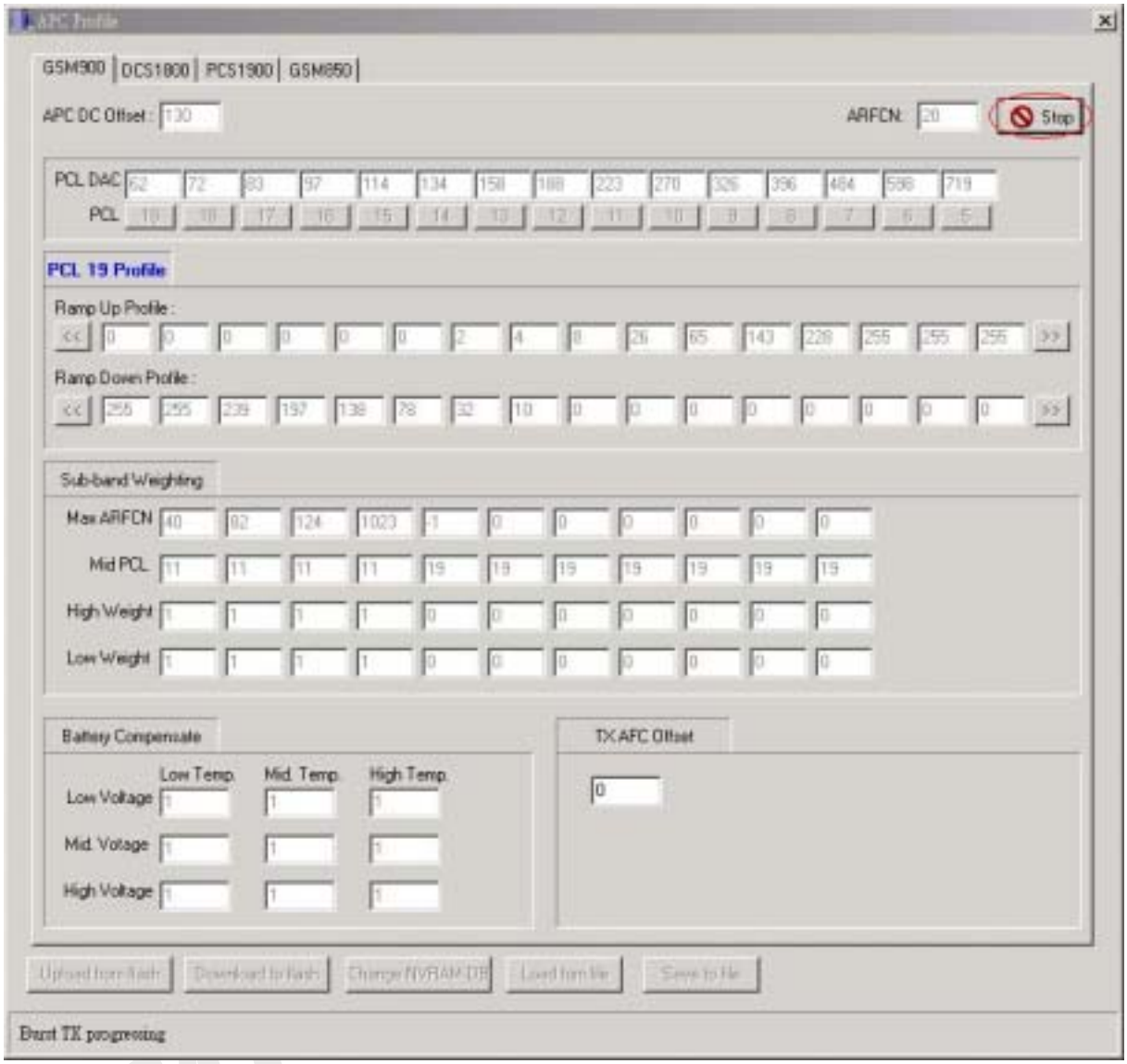

Figure 86 Click [Stop] button to stop testing

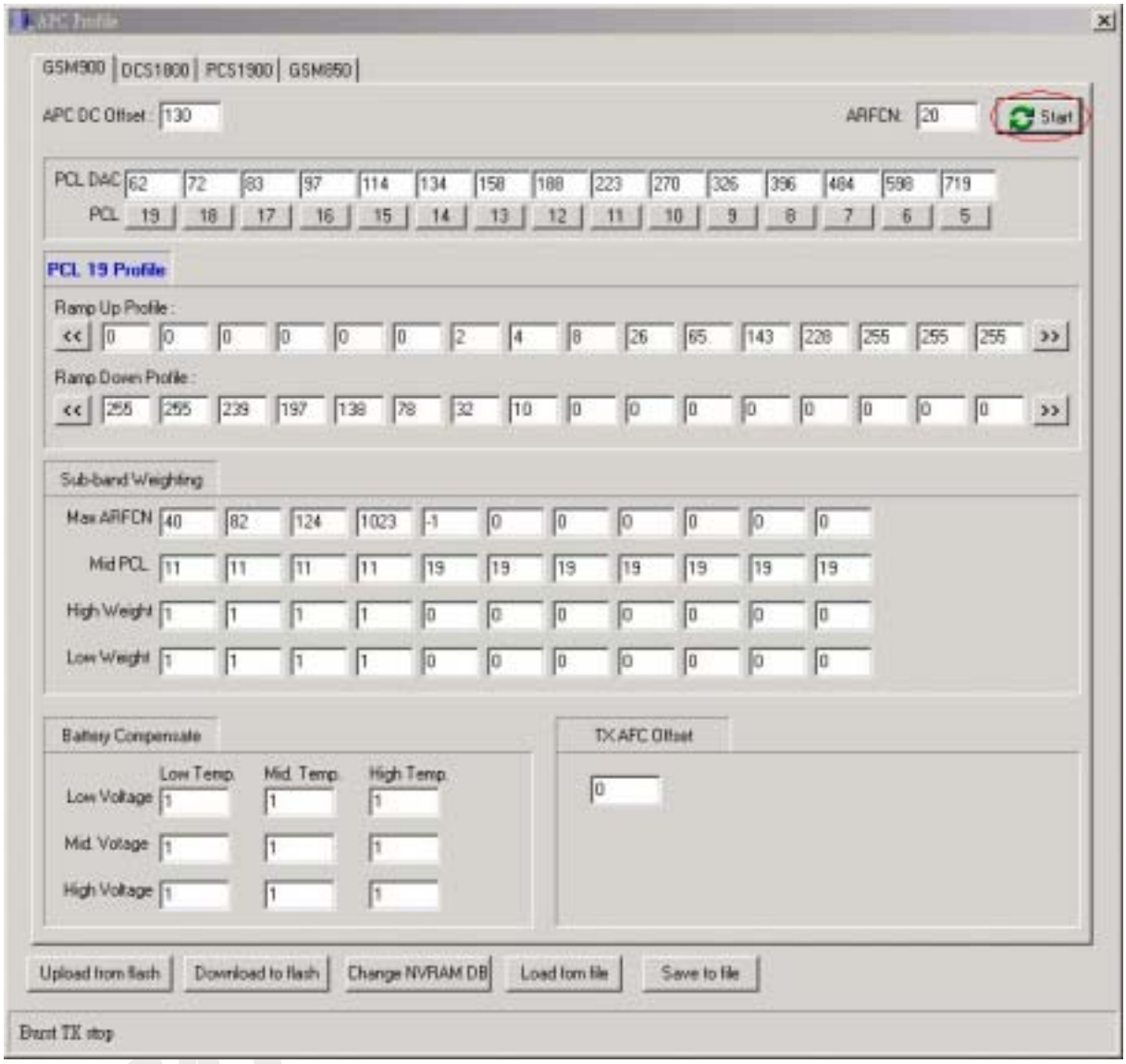

Figure 87 The caption of button will change to [Start]

3.2.5.5.a Read and write the level ramp table in flash

User can click [Upload from flash] button to read level ramp table from flash and click [Download to flash] button to write level ramp table to flash.

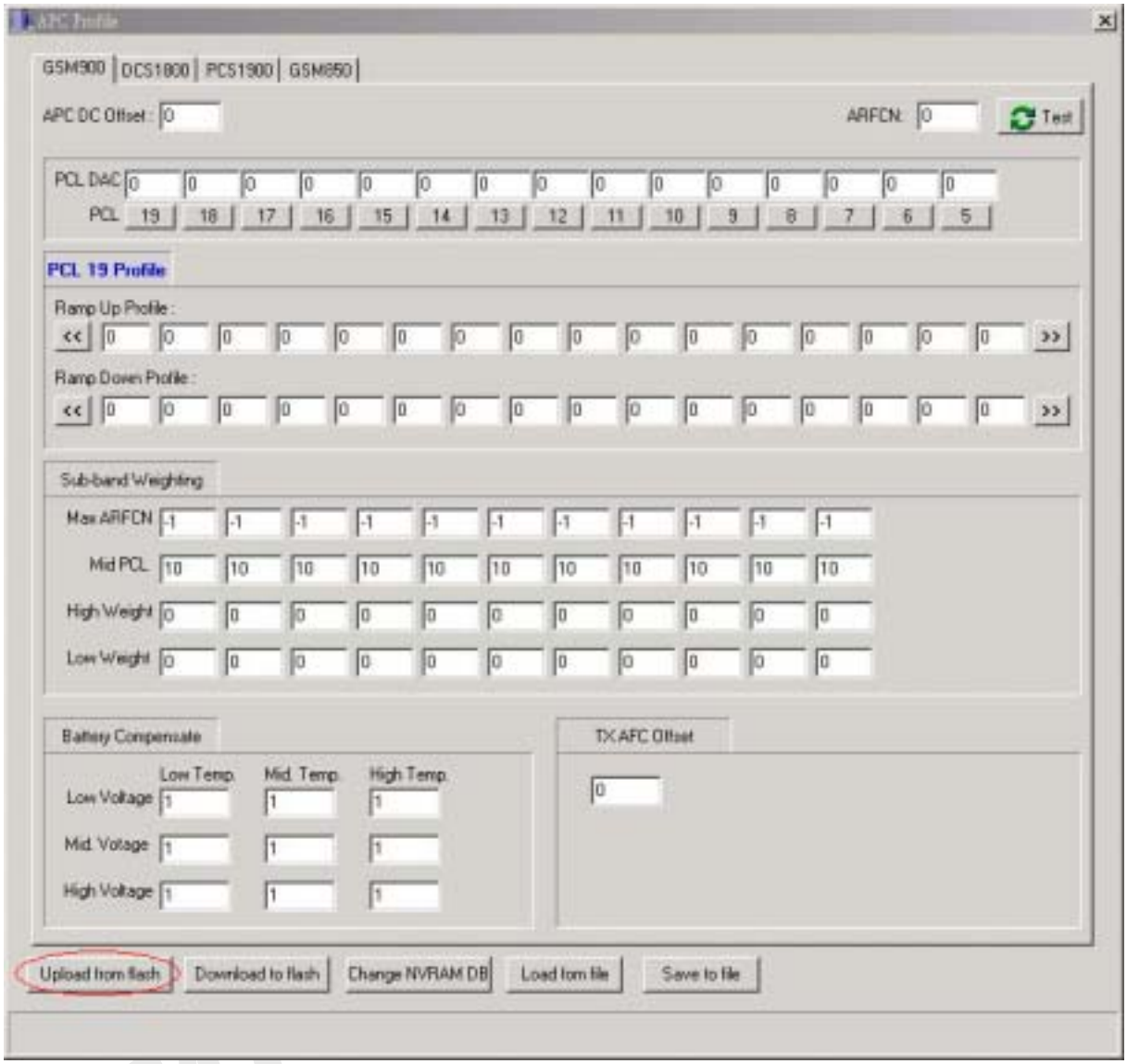

Figure 88 Click [upload from flash] button to read ramp table from flash.

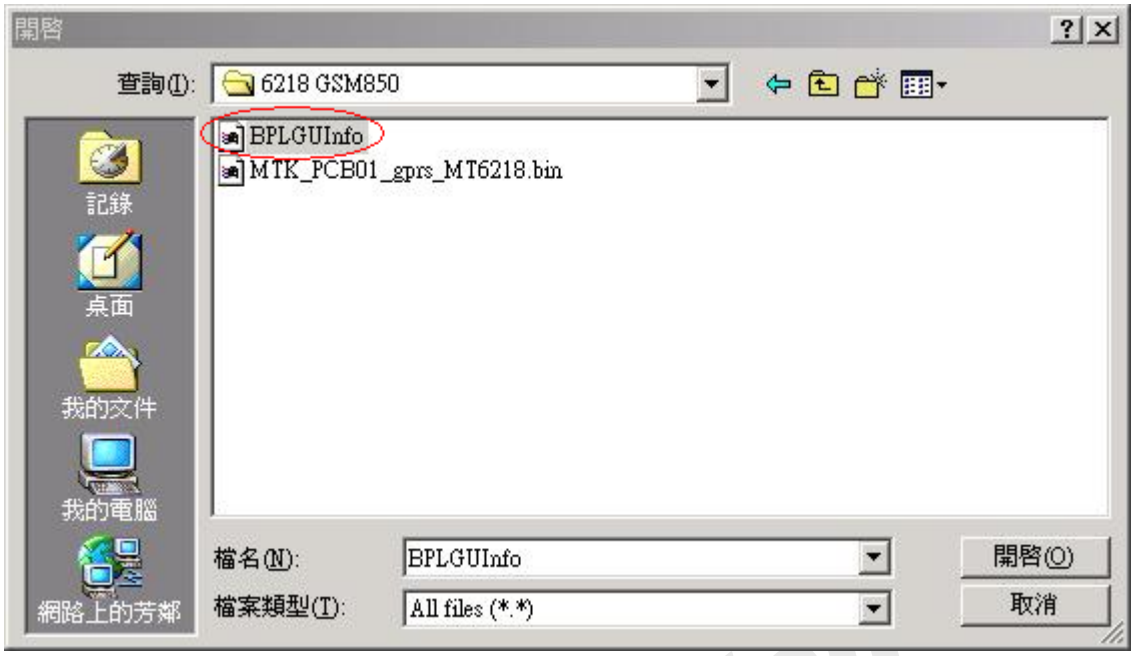

Figure 89 Select NVRAM database file if not selected before